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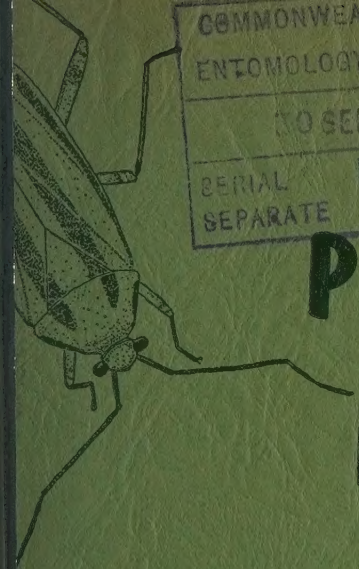

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION
NEW HAVEN • CONNECTICUT

Bulletin 600
1956.

PLANT PEST HANDBOOK

A compendium based on findings of research in plant sciences for three-quarters of a century

Bulletin 600 • October 1956

THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION
NEW HAVEN

FOREWORD

This Plant Pest Handbook presents in one volume some of the useful findings of research in plant sciences at this Station during three-quarters of a century.

In 1888, when the Station was 13 years old, the Board of Control appointed a plant pathologist, one of the first in the country. In the Station report for 1889 he published results from spraying grapes, plums, and potatoes with Bordeaux mixture. The unsprayed grapes, he said, "proved a total failure . . . while the treated rows yielded up to 75 per cent in good condition." The "untreated plum tree was defoliated in August," but "the treated trees held their foliage intact up to frost." And the "protection of the potato foliage must be considered very successful."

Thus were published for citizens of Connecticut the first words of the Station on plant pests. These researches and reports, so successfully begun, have been continued down through the years. Thus the Station has faced and helped to control the devastating outbreaks of San Jose scale, elm leaf beetle, gypsy moth, corn borer, Japanese beetle, tomato and potato blight, apple scab, red mites, white pine blister rust, Dutch elm disease, root rots, wireworms, and many other pests. The fight continues.

From this vast experience in dealing with plant pests, Station scientists have accumulated a wealth of information. A compendium, based on observations and research, was published in 1933 and 1934 in two small volumes called a "Plant Pest Handbook." This publication was one of the most popular ever issued by the Station, but it has long been a collectors' item.

We offer here a new edition.

Descriptions and the brief biological discussions of the insects and diseases in this handbook are in large measure timeless.

As a consequence of continuing research, control measures for the pests change rapidly, and there is every reason to expect that this will continue. Current publications of the Station and of the Extension Service, University of Connecticut, Storrs, present these changes as they occur.

Many people have contributed to this Plant Pest Handbook. W. E. Britton and G. P. Clinton were authors of the preceding edition, published in two parts. The records of many former staff members have been used, especially those of

B. F. Walden, M. P. Zappe, F. A. McCormack, A. A. Dunlap, G. H. Plumb, and Carl T. Parsons.

The scientists responsible for this edition are Philip Garman, J. P. Johnson, J. B. Kring, Frances W. Meyer, P. M. Miller, R. J. Quinton, Saul Rich, J. C. Schread, E. M. Stoddard, Gordon S. Taylor, P. E. Waggoner, and Malcolm E. Corden.

Most of the illustrations from the earlier edition were prepared by B. H. Walden, G. H. Plumb, Philip Garman, and E. M. Stoddard. Drawings made for this edition are the work of Joan T. Curtiss.

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References

Bulletins and circulars mentioned as references in this Handbook are publications of The Connecticut Agricultural Experiment Station. Numbers and titles of these publications (available for distribution when this Handbook was published) are as follows:

C 168 Chinch Bug Control in Lawns
C 175 Tobacco Seedbeds
C 176 Control of the European Corn Borer
C 186 Control of the Gypsy Moth
C 188 Ants as Pests
C 190 Lawns
C 191 Control of Some Tobacco Pests
C 194 Control of the Andromeda Lace Bug
C 200 Systemic Insecticides
C 201 Privet Thrips
SC Combating the Dutch Elm Disease
B 479 The Imported Long-Horned Weevil
B 564 Growing Tobacco in Connecticut
B 575 Control of Peach Insects
B 578 Scale Insects and Their Control
B 588 Aphids and Scale Insects on Ornamentals

Requests for any of these publications and for a List of Available Publications should be addressed to Publications, The Connecticut Agricultural Experiment Station, Box 1106, New Haven 4, Connecticut.

PLANT DISEASES AND INJURIES

Damage to plants from disease should not be confused with injury caused by insects. The measures used to control insects on plants differ from those used to protect plants against diseases. Fungicidal spray materials used to prevent plant diseases have little effect on insects, and insecticides are usually of no value in combating plant diseases.

The Causes of Disease

What is plant disease? In brief, we may define disease as damage to plants caused by fungi, bacteria, viruses, nematodes, and nutritional or physiological imbalances.

Fungi and bacteria are the most common causes of plant diseases. By living on plants as parasites, bacteria and fungi damage them. This damage we call disease.

Fungi, the cause of the greatest number of plant diseases, grow by producing cottony thread-like filaments that are called mycelium. When seen on the surface of the plant, the mycelium looks like a cottony growth, such as in white mold of beans. In many diseases the fungus is entirely within the plant, and only the damage it causes is visible. The great majority of plant disease fungi produce spores under the proper conditions. The spores are the tiny "seeds" of the fungus, which are blown and splashed about, spreading the fungus from plant to plant.

Viruses are disease-causing proteinaceous particles which are not visible under the ordinary microscope. Plants or animals infected by viruses are stimulated to produce virus protein at the expense of normal protein. It is this process which interferes with the normal existence of the infected plant or animal. The most common virus diseases of plants are the mosaics, such as tobacco mosaic.

Nematodes are microscopic eelworms which live in or on plant tissues, suck out juices of the plant, and generally disrupt the invaded tissues. This process causes sickly or damaged plants.

Nutritional disturbances very often resemble diseases caused by micro-organisms. Either too much or too little of a plant food may be involved. For example, too much fertilizer can "burn" plant roots, giving the injured plant a stunted sickly appearance, similar to that of plants damaged by root-rotting fungi. A deficiency of boron can cause brown spots to appear in the stems of certain crops such as cauliflower. Brown discoloration in plant tissues is also caused by invasion by micro-organisms.

Physiological imbalances resulting in plant disease are most commonly the result of sudden fluctuations in water supply and temperature. Fast-growing tissue may suddenly be deprived of water causing fruit spots, such as tomato blossom-end rot. Slow growing tissues may suddenly expand rapidly causing splitting, as for example of tomatoes or apples.

Closely related to damage caused by physiological imbalances are injuries caused by extremely cold or hot weather.

Cold Injury

Cold injures plants chiefly in two ways—by the so-called winter injuries when the plants are in a dormant or semi-dormant condition, and by early or late frosts when the plants are in active growth. Winter injuries vary greatly in the extent of damage to different species of plants but are especially severe to those normally grown in a

warmer climate. Cultivated and fertilized trees, especially if fertilization and cultivation is continued late in the season so that the tissues are not properly matured before cold weather sets in, are more subject to winter injury than are the wild species.

Man is anxious to grow a great variety of plants out of their natural climatic conditions and these naturally suffer most from winter injuries. Trees and shrubs are more subject to injury in this respect than are herbaceous plants since the latter, if tender, are usually properly protected or grown in greenhouses. Nurserymen, however, have learned largely by experience what woody species can stand winter conditions in various regions, and eventually they limit their stock to those species that escape injury in the normal winters. There are, however, always some species on the border line that are subject to injury, especially in very cold winters.

There are a great variety of ways in which trees and shrubs show these winter injuries, such as blackened sapwood, death of twigs and branches, cankers on the limbs or at the base of the trunk, injured or dead tap or side roots, death or injury to the leaf or flower buds. The presence of water in the soil, especially at the base of the trunk, and the absence of snow or other mulch for protection have their influence, as does the severity of the cold. In this state, fruit trees, especially peaches, are apt to be injured if the temperature drops below -10°F. Also, the exposure as to hillsides and valleys and the varieties of fruit trees grown are important factors. All winter injuries, however, do not come from unusually cold weather. Mild, warm winter days that tend to start sap circulation, followed by a sudden drop in temperature, may cause trouble. A not uncommon type of winter injury to evergreens occurs when warm, early spring days come before the frost is out of the ground. The leaves lose their moisture before it can be replaced by the roots because of their inactivity in the still cold or frozen soil. A scorch of the leaves follows, sometimes called winter-scorch. Underground parts of herbaceous perennials, of course, may be killed outright or be so severely injured that their growth the following season is abnormal.

Injury to plants resulting from late spring or early fall frosts is a familiar sight. Any exposed plant part can be injured.

Heat Injury

Heat injury appears in a variety of ways—as scorching, wilting of leaves, death of plants or their tissues, baking and dropping of fruits, prematuring and abnormal blossoming of vegetables. Sometimes the trouble is the direct result of the heat, but usually it is an indirect one resulting from lack or loss of water. Scorch of leaves often results when muggy days are suddenly followed by bright, hot days or when very dry weather accompanies a long period of hot days.

Prevention of Diseases and Injuries

Treatments for the control of *diseases* are largely preventive. The aim of this approach is to avoid invasion of the plant and further spread of disease to other plants. Experience has shown the difficulty of curing a plant, once it becomes diseased. Only in a few cases can plants be cured of disease at present. It is the aim of studies in plant chemotherapy to make this possible on a larger scale.

Disease-free Seeds and Plants

Some fungus diseases are carried in or on the seeds or plants when they are first planted. Such plant material may already be infected by mycelium, or spores may merely be on the tissues and ready to gain entrance under favorable conditions. Germinating seeds are often infected by such attached spores. So the first step in controlling fungus diseases is to use clean seed and plants. This is especially desirable in varieties that are known to be highly susceptible to certain diseases.

Certain smuts of grains gain entrance through spores that have already partially infected or are mechanically adhering to the seeds. It is much more desirable, therefore, to obtain seed from fields where smut is not present or at least not very evident, than from those where it was abundant the previous season. Likewise certain vegetables, such as celery with late blight, are known to carry disease through infected seeds. With perennial plants, it is much safer to avoid trouble by the use of bulbs, corms, tubers, etc. that come from fields or regions where there is no infection. Sometimes this infection can be discovered by a careful examination of the stock to see if rot, sclerotia, or some fruiting stage show. Seeds or bulbs are sometimes treated with fungicides to protect them. To avoid infection, as with mosaic on potatoes

and raspberries, certified tubers or plants are sold from fields where the absence of these troubles above a specified amount has been verified by inspection.

Immune and Susceptible Varieties

Some species and varieties, especially horticultural ones, are known to be resistant to certain fungus diseases. Unless one needs a particular variety for a special reason, use of a resistant type will avoid trouble later on. Frequently the susceptible variety of a food plant is more tender and better in eating quality, or, if an ornamental, has more beautiful blossoms. The grower naturally prefers these qualities and therefore increases his risk from disease. Many susceptible varieties, however, have no unusually desirable qualities. Plant breeders are constantly increasing the number of plants resistant to specific diseases.

Special Protections

Another way of avoiding trouble from plant diseases and injuries is by special care as to when, how, and where the plants are grown. The following precautions are indicated as examples.

Mulch. Mulch of snow, leaf, or earth often protects plants in this way. Where the wind has blown the snow away, the injury to orchard trees, especially at the base and roots, is more evident than in another orchard where the snow has remained as a protective layer. Likewise in severe winters, injury on certain shrubs, such as privet, merely extends down to the snow line. Other less hardy shrubs, such as box and certain evergreens, sometimes have to have special coverings to protect them from severe winter weather. In peach orchards especially, growers often protect the base of the trees by a dirt mulch to prevent an open space between the trunk and the surrounding earth in which water might accumulate and in severe weather cause a girdle type of injury.

Rotation. Crop rotation helps prevent the accumulation in the soil of diseases such as Fusarium and Verticillium which become increasingly severe when one susceptible crop is grown continuously. Any crop grown continuously on the same soil tends to build up an accumulation of spores from dead tissues that remain on the land after the crop is harvested. Rotation to a resistant crop, therefore, is a way to help avoid troubles of this type.

Clean culture. Clean culture is another way of lessening plant diseases. Clean culture not only keeps down the weeds, thus allowing the crop to get all of the available fertilizer and moisture, but also helps to get rid of the insects, especially aphids and leafhoppers, which might carry the germs from diseased to healthy plants. It also helps to keep out those weeds that may develop special fungus diseases, that can attack a closely related cultivated crop.

For example, clubroot can develop on certain weeds and so be a menace to cultivated crucifers planted there, even if the crucifers did not bring in the clubroot themselves. Likewise, downy mildew of spinach is the same or so similar to the mildew common on lambsquarters that there is a chance that the oospores commonly developed on the weed can carry trouble over the winter and become a source of infection to spinach planted on the same land.

Finally, sanitation involves gathering up and destroying the infected plant tissues in the fall. This reduces the amount of diseased material that can serve to spread disease the following year.

Watering

Moist or wet weather encourages the development and spread of diseases. Careless irrigation can also aid the spread of disease.

Greenhouse men are apt to use water too freely. They have found by experience that free watering at the right time develops luxuriant growth and blossoms of certain plants. At the same time, this practice favors the development of fungi as well. When signs of disease appear, care in watering is indicated. This is especially true when conditions are unfavorable for leaves to dry rapidly after watering.

In dry, summer weather occasional heavy drenching of the soil is apparently better practice than more frequent light watering.

Fertilization

Besides providing plant foods, careful fertilization may also help prevent attack by fungi and bacteria. Many fungi, such as Rhizoctonia, are more likely to invade poorly growing plant tissue. On the other hand, fungi and bacteria which cause leaf spots may be favored by lush, rank foliage that dries slowly. Excess surface moisture makes infection by pathogens more likely.

Liming may also have a profound influence

on amount of disease. For example, clubroot of cabbage is usually much more severe in an acid than in a neutral soil. On the other hand, potato scab is usually much worse in a neutral than in an acid soil.

Development of simple and accurate soil tests by M. F. Morgan of this Station has provided a satisfactory way to determine the materials required for proper growth of plants. Use of such tests enables growers to apply the necessary amounts of the various fertilizer ingredients.

Seed Treatments

Seed treatments may act in two ways. First, they may protect the seed and seedling from fungi in the soil. Second, they may kill parasites in or on the seed.

Most of the fungicides used to dust seeds act to prevent damping-off and seedling rots caused by soil fungi. These protectants may also kill spores clinging to the outside of the seed. Most of the seed soaking treatments kill spores clinging to the seed coat, and kill the mycelium within the infected seed. Killing fungus inside of seeds is extremely hard to do. There is no treatment that can be guaranteed to do this job completely. Some of the fungicide-soak treatments leave residues which also protect against soil fungi after the treated seeds are planted. Such seed treatments as dipping in hot water afford no protection against soil fungi.

The type of the fungicide, the length of treatment, and the character of the seed have all to be taken into consideration to secure the most harm to the fungus and the least harm to the seed treated.

Many of the soak treatments may cause much seed damage unless they are done very carefully. Directions for seed treating are generally given on the labels of fungicide containers. Directions for other types of seed treatments, such as soaking seed in hot water, may be obtained from the Agricultural Extension Service or from The Connecticut Agricultural Experiment Station.

Some of the fungicides used for seed protectants are thiram, chloranil, dichlone, captan, calomel, organic mercurials, and copper fungicides. The two most common seed soaks are hot water and solutions of bichloride of mercury (corrosive sublimate).

Soil Treatments

Soil may be treated to kill not only the microbes which cause disease, but also weed seeds. Not all treatments kill all microbes and weeds. Generally, soil treatments may be applied to pots, flats, benches, greenhouses, or coldframes used to start seedlings. Treating whole fields pays only when crops of high cash value are involved.

Soil can be treated with heat or with chemicals. Whatever the method, the soil should be loose, and have a medium amount of moisture for best results.

Heat may be applied by steaming, flaming, electrical baking, or by flooding with hot water. The hot-water method is the least desirable because it puddles the soil. Whatever the method the soil should attain a temperature of 160°F. and then cool slowly. Heating much above 160°F. may destroy the organic matter in the soil.

Some chemicals commonly used for soil treatment are formalin, chloropicrin, ethylene dibromide, methyl bromide, and a commercial mixture called D-D. All of these materials are volatile compounds which are toxic to growing plants and to animals. They should be used with caution and according to the directions on the label of the containers.

Formalin is commonly used for soil treatment. When treating piled soil, 2½ tablespoons of formalin may be used per bushel of soil (1¼ cubic feet). The formalin is diluted with water, thoroughly mixed with the soil, the soil then placed in flats and allowed to air out for 24 hours before seeding. For treating soil in seed beds or benches, 1 gallon of formaldehyde is used with 50 gallons of water. This solution is applied at the rate of 2 quarts per square foot of soil surface. For better penetration the soil is turned and then covered with burlap or Sisalkraft paper for 24 hours. After the cover is removed, the soil is spaded up and allowed to air out for 2 weeks before seeding.

Pots, flats, and tools may be sterilized by soaking overnight in a solution of 1 quart of formaldehyde in 25 gallons of water. After soaking, the tools are rinsed thoroughly for 2 days, and allowed to dry before using.

Recently, certain fungicides have been found effective for treating soil in which plants are growing. One of these is ferbam at the rate of 2 lbs. per 100 gallons, watered on the soil once a week. Another promising chemical treatment is the application of solutions of oxyquinoline sulfate.

Our research has shown that oxyquinoline sulfate solution applied to plants as a soil

drench helps them recover from infections caused by *Rhizoctonia solani.* This fungus lives in the soil and commonly causes damping-off, root rots, and stem rots.

How oxyquinoline sulfate acts we do not know. But treated plants frequently recover. Such plants put out new roots which remain healthy, and stem tissues appear to be made resistant to invasion by this fungus.

In our experience oxyquinoline sulfate works best against *Rhizoctonia* sp., but it may also be effective for the control of certain diseases caused by species of *Fusarium* and *Pythium.*

In general a concentration of 1:4000 is most practical. For controlling orchid diseases a 1:2000 solution is more effective. A 1:4000 solution of oxyquinoline sulfate is made up by adding 1 level teaspoon to 3 gallons of water, or 1 pound to 500 gallons. The solution should be a clear, deep yellow. Water of high mineral content may make a cloudy or green or black solution, in which case the solution will not control *Rhizoctonia* and may even be injurious to the plants. Oxyquinoline sulfate has an affinity for heavy metals and for this reason should be mixed only in clean containers. It is practical to apply the solution through the central watering system used in many greenhouses if the proportioning system is correctly calibrated.

For most uses a pint of oxyquinoline sulfate solution per square foot is sufficient. In treating trees or shrubs a thorough soaking of the soil is adequate, and a watering can is a good way to apply it. In the case of potted plants the equivalent of a good watering is applied. Severe infestations may require more than one application, spacing the treatments 3 to 7 days apart. The number of applications required will depend on the crop and the severity of the trouble. Applications made immediately before or after a rain (or watering) do no good because the material is thereby diluted below its effective concentration.

We have applied oxyquinoline sulfate to a wide range of plants with few evidences of toxicity. The solution may spot the leaves of beets and celery; the spotting is soon outgrown and can be avoided by flowing the solution over the surface of the flat rather than sprinkling it on. Erfurt variety of cauliflower is retarded in growth, but so far other varieties of vegetables tested are not hurt by the chemical. Delayed germination results from application to most seeds at planting time: lettuce is delayed 5 days. Because of this growers who want to meet a market date will find applications to seedlings as they break through the soil more satisfactory.

This solution can be applied to woody cuttings at any time, but herbaceous cuttings do not root satisfactorily if the chemical is applied before roots have formed. After roots have formed, the oxyquinoline sulfate may be safely applied also to herbaceous cuttings either as a protective or curative measure.

Oxyquinoline sulfate has proven valuable in checking the progress of *Rhizoctonia* root rot in the field on woody plants, in hedges, and in nursery stock. However, this treatment is in no way a substitute for soil sterilization before planting and the use of clean planting stock.

Tree Wounds

Good care of tree wounds consists of shaping and painting cut surfaces. Cankered or decayed areas should be cut away or scraped out to sound wood and pointed at top and bottom to facilitate callus growth. Painting any cut more than one inch in diameter is accepted practice. Any good white, gray or black house paint may be used. However, any paint containing creosote (as do many roof and water-proofing paints) will injure and may even kill the tree. An antiseptic paint may be made by mixing Bordeaux powder as purchased with enough raw linseed oil so that it can be brushed on.

Fungicides

Before 1940, the problem of choosing a fungicide was fairly simple. The three most common materials were Bordeaux mixture, sulfur, and lime sulfur. Although these three materials are still useful, the grower now has a sometimes bewildering array of fungicides from which to choose. These newer materials, byproducts of a burgeoning chemical industry, can compete with the older fungicides principally because they are better for certain jobs, and usually cause less plant damage.

Certain of the newer fungicides are excellent all-around protectants useful against a large number of diseases. Some of these are nabam, zineb, maneb, thiram, and captan. Research at The Connecticut Agricultural Experiment Station was responsible in a large measure for the successful development

of nabam and zineb. Others are more specialized fungicides, especially good for the control of a few diseases and not so good for the control of others. Newer fungicides of this kind are ziram, ferbam, the neutral copper preparations, dichlone, chloranil, glyodin, and the phenyl mercury compounds.

Another specialized material of this kind is methylheptyldinitrophenyl crotonate (also called Karathane), a fungicide particularly good for the control of powdery mildews. The development of Karathane was also aided by research of The Connecticut Agricultural Experiment Station.

Because most of these fungicides are sold under many trade names, no attempt will be made here to list them. The buyer and user of fungicides usually can get all the essential information from the labels of the containers. Stringent regulations now govern label claims. The package must contain the percentage of fungicide stated on the label. Before a label can claim that a fungicide will control a certain disease, the claim must be approved by governmental experts and substantiated by experimental data. The label also gives particulars on how and when to apply the fungicides for best results, and to avoid leaving poisonous residues on edible plant products.

It is beyond the scope of this handbook to give details for the use of each fungicide. Details are given only in those cases where it is thought that the information will not be found on container labels, or in the yearly spray schedules available from the Extension Service and The Connecticut Agricultural Experiment Station. The control measures for each disease merely mention the best control materials to use, if there are any available fungicides worth using. The importance of reading labels and instructions enclosed in packages cannot be overstressed.

It is probably worthwhile to describe the preparation of Bordeaux mixture. Bordeaux is a mixture in water of copper sulfate (blue vitriol) and fresh, spray-grade, hydrated lime. In expressing the concentration of Bordeaux, 8-4-100 for example, the first figure refers to pounds of copper sulfate, the second figure to pounds of lime, and the third figure to gallons of water. For preparing Bordeaux, dissolve the copper sulfate separately in a small quantity of water, and also mix the lime separately in a small quantity of water. Add the copper sulfate solution first to the final volume of water. Stir well. Then stir in the lime. For best results, Bordeaux should be prepared immediately before using, and constantly stirred while being mixed and sprayed.

One gallon lots of Bordeaux may be made as follows: Dissolve 1 ounce of copper sulfate in ½ gallon of water, and ½ ounce of lime in another ½ gallon of water. Mix the two together with stirring just before using. This amount of Bordeaux should cover about 50 to 75 feet of row when applied with a hand sprayer.

Fungicide Application

Which is best for the control of plant diseases, spraying or dusting? As a general rule, dried spray residues are much more weather-resistant than dust deposits. Because the effective residue has to be on the leaf before the spores arrive, spraying is considered to be more effective than dusting for controlling plant diseases. Experiments at The Connecticut Agricultural Experiment Station have demonstrated this to be so. A grower may prefer to dust because of equipment limitations. Dusting with fungicides may afford a measure of protection against plant diseases, but spraying results in better disease control. This is particularly true during wet weather, when diseases are most likely to attack, and the fungicide deposits on the foliage are being most severely eroded.

It is well to know that the fungicidal preparations used for dusting are quite different from those used for spraying. Fungicides prepared for dusting have much less active ingredient than those formulated for spraying. Fungicides for spraying are made up as wettable powders that mix easily with water. It is important that the user specify how the fungicide is to be applied when buying.

Regardless of whether one sprays or dusts, it is extremely important that the plant to be protected be well covered with the fungicide. The application of fungicide is similar to painting a house. If there is a peeled spot in the painted surface, rots may enter. The same is true of a fungicide cover on a plant surface. Bare spots allow diseases to enter.

Although adequate coverage is essential, it is best not to over-spray. Research at The Connecticut Agricultural Experiment Station has shown that overspraying may wash off the residue already deposited on the leaf.

The plant grower not only has a wide choice of materials to use, but can also choose

from a great variety of sprayers and dusters. The choice of equipment will depend mainly upon the size of the growing operation, and the likes and dislikes of the operator.

Two recent developments in application may well be mentioned here. These are the mist blower, and low-pressure, low-volume spraying. Much of the early research responsible for the development of the mist blower was done at The Connecticut Agricultural Experiment Station in cooperation with the U. S. Department of Agriculture. This type of sprayer introduces concentrated pesticide into an air blast that carries the droplets to the plants. Fungicides have been successfully applied to trees using mist blowers. To date, however, mist blowers have been less satisfactory than conventional sprayers for applying fungicides to row crops.

The low-pressure, low-volume sprayers are light, hydraulic rigs applying about 80 gallons of spray per acre at a pressure of about 100 lbs. per square inch. This is in contrast to the conventional hydraulic sprayers which may apply 300 to 500 gallons of spray per acre at pressures ranging up to 600 lbs. per square inch. When a low-gallonage sprayer is used, the concentration of the spray liquid may be two or more times that used in the conventional hydraulic sprayer. The concentration is usually such that the amount of actual fungicide per acre is about the same as that from the conventional sprayer, even though the volume of liquid in which it is applied is less.

For example, 2 pounds of fungicide per 100 gallons of spray applied at the rate of 300 gallons per acre from the conventional hydraulic sprayer amounts to 6 pounds of actual fungicide per acre. The same 6 pounds of fungicide per acre would be applied from a low-gallonage sprayer in whatever volume of liquid it distributed per acre. The low-gallonage, low-pressure rigs have been used successfully in other states to protect tomatoes and potatoes against diseases. These rigs are so light that they can be used in rain-soaked fields, where conventional hydraulic sprayers would bog down. On low-gallonage rigs drop nozzles have given the most adequate coverage and best results.

INSECTS AND THEIR INJURY TO PLANTS

Insects are small animals classified as Hexapoda, which means six-legged. They have external skeletons, jointed appendages, and most are winged when adults. Spiders and mites have external skeletons but have more than six legs. Sowbugs, centipedes, and millipeds are also relatives which have many legs. Insects are by far the most abundant animals in the world, both in number of species and in numbers of individuals. Fossil remains show that insects inhabited the world long before other animals now living appeared.

A large proportion of insects obtain their food from plants. The bees live on nectar and pollen from flowers. The larvae of many beetles, moths, butterflies, and flies live in or on plants. Many bugs suck the sap or cell contents from plants as a source of food. Many other insects, such as the parasitic wasps, feed as parasites, usually in the bodies of host insects. Others, such as the praying mantis, some of the beetles and the predaceous bugs, many ants and some wasps, prey on other insects. This publication deals only with the insects more commonly seen as pests of plants.

How Insects Develop

Most of the chewing insects have four distinct stages of growth: (1) egg, (2) caterpillar, grub or larva, (3) pupa, and (4) adult insect. This type of development is known as complete transformation. The sucking insects, and such chewing insects as grasshoppers and crickets, have not more than three stages: (1) egg, (2) nymph, and (3) adult. This sort of development is known as incomplete transformation.

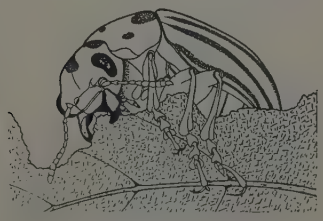

Figure 1. A chewing insect.

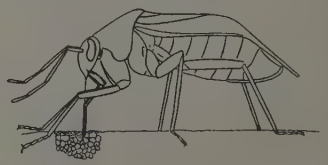

Figure 2. A sucking insect.

The external skeleton of insects is relatively rigid, and cannot be stretched very much. As insects grow they split the old skeleton, crawl out of it, and harden a new skeleton larger than the old one. The process of molting is controlled by hormones.

The time required for development of insects from egg to adult varies from a few days for flies to 17 years for a cicada.

How Insects Injure Plants

Insects may feed on roots, stems, leaves, and flowers of plants. The chewing insects actually consume the infested parts. The sucking insects remove cell contents or "sap" and weaken the plants. Some of these sucking insects inject salivary fluids into plants.

This secretion may (1) kill plants, as scale insects do, (2) cause galls to form, as in the case of gall aphids, or (3) kill portions of a leaf, as in leafhopper "burn." A few insects cause their damage by cutting the plants for egg-laying.

How to Live with Insects

Many plants seem to offer a wonderful breeding place for many kinds of insects. Apples, cabbage, corn, elm, grape, grass, maple, oak, peach, pear, pines, poplar, potatoes, roses, and tobacco have a great many serious pests. However, insects seldom destroy these plants. The threat of damage by insects need not prevent an attempt to grow any of these plants. A knowledge of what to expect and how to control the pests when they are destructive enables anyone to live with the insect problem.

Some insects seem to vary little in abundance. Flea beetles, striped cucumber beetles, plant bugs, scale insects, and many others are perennial pests. The slight fluctuations in abundance are insufficient to make much difference in damage. Other insects seem to be influenced easily by the weather. Temperature and rainfall seem to govern the numbers of aphids, mites, and some scale insects. The third type is represented by the gypsy moth, canker worms, and tent caterpillars. These pests have a pronounced cyclic abundance apparently produced by interactions with parasites.

How Insect Pests are Controlled on Plants

Many pests, particularly bark beetles and borers attacking shrubs and trees, seem to be attracted to injured or weak plants. Keeping the plants in good growing condition by prevention of mechanical injury to the bark, judicious use of fertilizer, particularly early in the growing season, and of irrigation during droughts helps reduce the hazard of infestation by these pests. Infestation by leaf-feeding insects does not seem to be reduced by increased vigor, but the appearance of the plants is improved. Cutworms, wireworms, and white grubs may be favored by an abundant supply of organic matter in the soil. However, the benefits of organic matter far outweigh this slight disadvantage.

Nature "controls" the abundance of most insects. When destructive outbreaks occur, it is necessary to decide whether it is preferable to "let nature take its course" and possibly lose plants, or to apply insecticides as an immediate and often temporary protection.

If insecticides are to be used successfully, they should be applied before damage is severe. These chemicals will not revive dead twigs or trees or replace holes eaten in leaves.

Many pests can be controlled by dusts. Most leaf-feeding insects come in this category. However, dusts do not persist long on plants, and their control of insects does not last long. As a general rule, sprays are effective over a longer period because residues remain on plants. Sprays seem definitely more effective than dusts in controlling scales, mites, aphids, and many serious pests of fruit.

Insecticides

A large number of highly effective insecticides has been developed. Few can be classified as non-poisonous to man, but many others are so mildly poisonous that they may be used with no danger whatever. Legislation requires that all the labels on all insecticides give full directions for use, including all necessary precautions. These labels are important sources of information and may be followed with confidence. Since this information is available on each package, it is unnecessary to repeat the directions in this handbook.

All of the insecticides mentioned in this publication have been studied thoroughly at this Station. They have been used in experiments either on the crops and pests or on closely allied pests. All are reasonably safe to the gardener or farmer. If used as directed on the package, none leaves a dangerous residue on fruits and vegetables.

Arsenate of lead has been a standard spray for control of chewing insects. It is available as a wettable powder for use in spray and as a dust. It is not effective in controlling sucking insects. It is now used chiefly on shade trees and for certain pests of fruits.

Nicotine sulfate is one of the oldest insecticides in common use. It acts only by contact with the insect and disappears from plants very quickly. It is used mostly for control of aphids. Addition of a small amount of soap increases its effectiveness.

Pyrethrum is one of the few materials that is practically non-poisonous as used. It kills on contact, and is most useful on pests of vegetables.

Rotenone is also practically non-poisonous.

It persists longer than pyrethrum. It too is a preferred material for vegetables.

Chlorinated Hydrocarbon Insecticides

DDT is a synthetic organic compound highly toxic to many insects. It penetrates the integument of many insects very readily. Continued use of DDT on woody plants may cause mites and scales to increase in abundance by killing their predators. Houseflies, cabbage worms, and potato flea beetles have become resistant to DDT in Connecticut.

TDE and Methoxychlor are chemical relatives of DDT useful in controlling some pests that DDT will not kill. Methoxychlor is also preferred for use on cucurbits.

Chlordane has been particularly effective in controlling insects in the soil.

Heptachlor, dieldrin, and endrin are chemical relatives of chlordane useful in specific instances.

Lindane is especially useful on ornamental plants, and is very toxic to many scales, aphids, and leaf feeders.

All of the chlorinated insecticides are available as wettable powders and emulsifiable liquids for use in sprays and as dusts.

Organic Phosphates

Malathion has been very effective in controlling many insects, especially aphids and scales. Its toxicity to humans is very low, and its residues disappear from plants relatively rapidly. It is well adapted for use in both vegetable and flower gardens.

Dormant Sprays

Dormant oil sprays, and particularly the "superior" type, are very useful in killing scales, aphids, and mite eggs on dormant deciduous trees and shrubs. They are usually applied in the early spring after danger of freezing weather and before buds swell.

Lime sulfur solution is an effective dormant spray for control of scales.

Dinitro compounds are available for special uses as dormant sprays.

PLANT PESTS

Information on a specific plant pest or injury is described on this and the following pages under the headings of the common, or most important host plant. Cross references key this information to other hosts on which the trouble is likely to occur. Host plants are arranged in alphabetical order, by common names. For host plants commonly injured by both diseases and insects, information on diseases and related disorders precedes that on insects.

A

Abutilon

Mealybugs. Abutilon plants in greenhouses are commonly infested with mealybugs. See Lantana.

Greenhouse whitefly. This whitefly commonly infests abutilon plants in greenhouses. See Tomato.

African-violet

Ring spot. Irregular or ring-like pale tan spots appear on the upper side of the leaves and may vary greatly in size. The cause is believed to be the use of cold water for watering the plants. Pale green foliage may accompany the blotches and indicates too much light. Shading and watering with water of room temperature or slightly warmer will prevent this trouble. Contrary to popular belief the plant can be held under a gentle stream of water to wash the dust from the foliage if the water is lukewarm.

Root-and-crown rot, *Rhizoctonia solani* and *Pythium ultimum.* The infection may show first as wilting and general droopiness of the foliage accompanied by browning and rotting of the roots and often of the crown. Death of the outer leaves follows, until finally the entire plant is dead. This rotting of outer leaves is not to be confused with a similar rotting of leaves that touch the edge of clay pots while the remainder of the plant looks healthy.

The same symptoms of root-and-crown rot may be observed when the fertilizer level of the soil is too high, often resulting from the use of household plant foods. African violets do best in a porous soil of medium richness. Laboratory analysis is necessary to distinguish between the fungus infection and the fertilizer burn.

The fungus trouble has been controlled by watering the plant with a solution of oxyquinoline sulfate (½ teaspoon in 1 gallon of water) several times in place of watering (see p. 5). When overfertilization has caused the rot, repotting is indicated with a much less rich soil. Leaf cuttings from highly fertilized plants do not root as quickly as those from plants kept at a lower nutritional level.

Foliar nematodes, *Aphelenchoides fragariae.* Light blotches appear on leaves. These areas enlarge and eventually involve the entire leaf and plant. Picking and destroying affected leaves and avoiding splashing water from leaf to leaf or from soil to leaf give fair control. These nematodes can exist for a short time as saprophytes in the soil, so that repotting at the time of picking leaves is most effective. Systemic insecticides may be used, but caution should be used in handling them.

Powdery mildew, *Oidium* sp. White mealy spots appear on leaves. Sulfur sprays or dusts two or three times at weekly intervals should give good control.

Dwarfing. Dwarfing and stunting of the new leaves, which are often distorted and hairier than normal, indicates infestation by cyclamen mites. See Cyclamen.

Nitrogen excess. Some cases of fertilizer burn resembling damping-off have come to our attention. This trouble has occurred chiefly on seedlings and African violets. In suspected cases laboratory tissue tests and soil analyses are necessary for correct diagnosis and often reveal excessive nitrogen as the cause of a trouble very much like damping-off.

Cyclamen mite. See Cyclamen.

Ageratum

Sclerotinia rot, *Sclerotium rolfsii.* Plants wilt and die. White cobwebby mycelium is found on stem at ground level in which may be found seed-like sclerotia ranging in color from buff to reddish-brown. Roguing infected plants and removal of infested soil to a depth of 3 inches is indicated. Or a solution of bichloride of mercury 1:1000 (see p. 78) may be poured around the plant. This stops mycelial growth and kills many sclerotia, although certainly not all.

Greenhouse orthezia. This insect is a common pest of ageratum in greenhouses. See Lantana.

Greenhouse whitefly. This plant in greenhouses is very susceptible to infestation by the greenhouse whitefly. See Tomato.

Mealybugs. Ageratum plants in greenhouses are often infested with mealybugs. See Lantana.

Red spider mite. See Phlox.

Ailanthus (Tree-of-Heaven)

Wilt, *Verticillium albo-atrum.* Leaves yellow and fall, followed by death of a branch or branches or the entire tree. Brownish streaks are present in the wood. Pruning well back of the affected wood may prevent the fungus from spreading into the rest of the tree, and painting the wound with a protective paint (see p. 5) is preferred. If the discoloration extends into the main trunk, the tree may as well be removed. Elms, maples, and catalpas are susceptible to this fungus and are likely to become diseased if used as replacements.

Alfalfa

Downy mildew. Infected young shoots turn pale green, then yellow, and become covered with a greyish-purple mold. Where the fungus invades the main stem, the stem is swollen and the foliage chlorotic. Some varieties are more resistant than others, and the only practical control is by using resistant varieties.

Spring black stem. Although the fungus causing this disease may attack any part of the plant, the principal symptom is dark brown to black lesions on the lower part of the stems and leaf petioles. Young shoots may be girdled and killed. Infected leaves yellow and wither before they drop. Small black fruiting bodies of the fungus usually appear on lesions of the previous season. This disease may be particularly damaging during a cold, wet spring when young shoots are usually severely stunted. Use of resistant varieties and burning or removal of old stems early in spring before new growth begins will help control this disease. A legume-free crop rotation may also be helpful.

Summer black stem and leaf spot. This disease differs from spring black stem in that it occurs mainly on the upper parts of the stems rather than the stem bases. The leaf spot phase is usually unimportant and is distinguished by rounded spots with dark brown or black centers. Stem blackening occurs particularly in late summer. Burning or removal of old leaves and stems from previous crops, and a legume-free crop rotation, help to reduce the build-up of the fungus.

Common leaf spot. Numerous small circular brown-purple spots that do not coalesce are produced on infected leaves. In severe infections the leaves turn yellow and drop. Minute disk-like fruiting bodies eventually form on the upper surface of each spot. Small elliptical spots may also appear on stems. No control is known except that a few individuals (about 10 per cent) of the alfalfa strain Du Puits are highly resistant.

Leptosphaeria leaf spot and root rot. Although this disease is primarily a root rot, circular leaf spots or blotches of pale tan with light brown margins may be the first sign of infection. The roots and crown are rotted with a brown or black discoloration that usually appears the second year or later. Control is chiefly by burning or removal of

all old stems before spring, and a long legume-free crop rotation.

Sclerotinia crown rot. Shoots turn pale green, wilt and become yellow. The crown of the plant is covered with a white mycelial weft in which irregular black sclerotia may be found. This disease is particularly evident in the fall, winter, and early spring. The control measures are the same as those listed for Sclerotinia crown rot of clovers.

Root rots and wilts. Root rots and wilts usually appear in the spring and early summer and are caused by a variety of fungi and one bacterial disease. Bacterial wilt may be distinguished by a pale yellowish ooze in the conductive tissue of the tap root and stem. There is no practical control for these diseases other than the planting of resistant varieties. Determination of the causal organism can be made in the laboratory.

Winter injury. This nonparasitic disease may be a major factor in causing unthrifty alfalfa stands in areas with severe winter conditions. Injured tissues often become an avenue for the entrance of parasitic micro-organisms. Plants damaged in this way may be distinguished by a general rot of all tissues of the crown and primary root. Effects of winter injury may be lessened by planting winter hardy or adapted varieties.

Low temperature crown rot. A low-temperature basidiomycete causing symptoms similar to winter injury has been reported from Canada where killing occurred about the time of the first spring thaw. Plants are killed in irregular patches which may get larger from year to year. Resistant varieties and crop rotations without a susceptible legume host for at least 4 years are the best control measures.

Stem nematode. This disease is particularly destructive during periods of high moisture. Diseased seedlings may be severely stunted and seldom recover, while established plants are severely damaged in the crown region. Infected buds are thickened and deformed in the early stages of disease, while later the stem base and buds become brown or black. The variety Nemastan has 85 per cent resistance to this disease.

Root knot and meadow nematode diseases. Root knot and the disease caused by the meadow nematode are not serious problems of alfalfa culture, but alfalfa serves to perpetuate these nematodes in an infested soil.

Yellows and dwarfing. Boron deficiency in alfalfa is characterized by yellowing and dwarfing of the plants with some bronzing of the leaflets, shortening of shoot internodes, and death of terminal buds. White or yellow spots scattered in a crescent along the margin of the leaflets followed by yellowing and dying of the tips of the leaflets may be due to deficiency of potash, calcium, or phosphate. These symptoms are usually distributed over the whole plant, and by the time the symptoms appear, it is usually too late to apply corrective fertilizer treatments for that cutting. Soil analyses are indicated.

Several virus diseases of legumes, i.e., mosaic, witches'-brooms, and dwarfing, are noted on alfalfa as carried by insects and/or grafting, but as yet they have not been reported from this state.

Blister beetles. Several species of large, slender, active soft-bodied beetles occasionally feed upon the leaves of alfalfa. They are usually dark colored and sometimes have thin white lines on their wing covers. The eggs are laid in the soil. They hatch into active larvae which burrow through the soil until they find an egg mass of a grasshopper. On this egg mass they feed, usually in groups, and develop. No special control has been needed for these insects on alfalfa.

Clover bud weevil. See Clover.

Clover leafhopper. See Clover.

Clover leaf weevil. See Clover.

Clover root curculios. See Clover.

Grasshoppers. See Meadow.

Figure 3. Spittlebug on alfalfa.

Meadow spittlebug, *Philaenus leucophthalmus*. The feeding of nymphs, indicated by the presence of spittle masses, may cause severe damage to alfalfa and clover up to the time of first cutting. See Meadow.

Pea aphid, *Macrosiphum pisi.* Large green aphids with prominent red eyes and long slender legs occur on the leaves and stems, from which they suck sap, occasionally causing great damage. They are most abundant in the spring and fall and overwinter on alfalfa and clover in the egg stage. They can be controlled with a malathion spray.

Potato leafhopper, *Empoasca fabae.* During mid-season leafhoppers may cause a stunting and yellowing of the crop, as they suck sap from the undersides of the leaves. This insect is pale green with transparent and colorless wings and wing covers. It is about one-eighth of an inch long. It does not overwinter in Connecticut but migrates north each year from the Gulf states. Potato leafhopper can be controlled by the application of malathion to young plants.

Tarnished plant bug. See Meadow.

Wireworms. See Meadow.

Almond (Flowering)

Brown rot, *Sclerotinia fructicola.* Flowers wither and branches die soon after blossom time; the fungus is often found fruiting on the dead flowers as grey tufts of mold. The same organism causes brown rot on peaches, cherries, and other stone fruits. Blossom infection is usual on the flowering almond, the spores being carried by pollinating insects. Full-blossom sprays of sulfur or dichlone will help materially to control this trouble. Also pruning and burning infected wood and planting away from other stone fruits or ornamental cherries and plums will help. Flowering almond is very susceptible to this disease. Some other fungus diseases occurring on peaches may appear on flowering almond.

Amaryllis (Hippeastrum)

Red fire disease, *Stagonospora crini.* Red spots or blotches appear on leaves, flower stalks, flower parts, or bulb scales. The origin of the trouble is thought to be an injury to leaves and stems from pushing through the soil or from an infestation of tiny mites on the bulbs followed later by infection with the fungus. The fungus may be present in the bulbs, so that badly infected bulbs should be discarded.

Bulb treatment by soaking bulbs 2 hrs. in bichloride of mercury 1:1000 (see p. 78) before planting will help control the fungus. Keeping foliage dry coupled with good ventilation and plenty of light should decrease chance of fungus spread. Spraying foliage with Bordeaux or thiram plus a spreader may be helpful.

Mosaic. Virus. Mottling of foliage with white or pale yellow spots (often turning red), stunting of flowers, and death of leaves indicate this trouble. Destruction of infected plants prevents spread to healthy ones.

Figure 4. Andromeda lace bug.

Andromeda

Andromeda lace bug, *Stephanitis globulifera.* Feeds on the Japanese Andromeda, *Pieris japonica,* and occasionally on *Azalea kaempheri* but rarely if ever on other broadleaf evergreens including *P. floribunda.* Both adults and nymphs suck the sap from the underside of the leaves, causing a mottling or blanching. The adult lace bug is about one-eighth of an inch long. The head covering and markings on the wings are intensely black. Eggs overwinter in the underside of the leaves near the ground mostly. There are three or four broods. Control measures are described in Circular 194. Malathion, DDT, or nicotine sulfate spray applied the last week in May was highly effective.

Apple

Scab, *Venturia inaequalis.* This fungus causes circular, olive-black spots on the leaves, fruit, and young fruit stems. Heavy infection will cause dropping of young fruits, distortion and cracking of growing fruit, as well as extensive defoliation. The fungus overwinters on the fallen infected leaves, producing a spore stage in the spring which infects the young leaves and fruit during periods of rain. Infection can take place, with suitable weather conditions, at any time after growth starts until the middle of June. During the summer a different spore form is produced, on the leaves and fruit, which con-

tinues to produce new infections when washed onto leaves and fruits by rains. During heavy fall rains these summer spores may cause late fruit infections which will develop in storage as typical scab spots, or rarely as small black lesions without the usual production of spores. It is doubtful if scab infection of fruit takes place in storage. From all this the program of control is obvious, scab must be prevented from getting started in the spring and this protection must be given the trees until well into the growing season. The timing and thoroughness of the spraying is essential regardless of the fungicide used.

Crown gall, *Agrobacterium tumefaciens.* A bacterial disease causing woody galls on the roots and at the crown of the tree. The causal organism probably enters through small wounds caused by handling or by insects or nematodes. This disease is neither common nor important in orchard trees in the northern states although it occasionally causes minor injury to nursery stock. Experimentally the growth of crown gall has been arrested by injection of various materials into the gall, but to date no practical field control has been devised.

Fire blight, *Erwinia amylovora.* This is a bacterial disease which kills the twigs, foliage, and fruit. The wood of the infected twigs is black or dark brown and the bark is darker than normal. The edge of the infected area of bark is slightly sunken and very sharply defined. The most characteristic symptom is shown in the foliage and young fruit which are a black brown and remain firmly attached to the dead twig. Infection occurs on the blossoms and spreads into the fruit spur and immediately adjacent branch. Fire blight is usually not serious in Connecticut on apples and control measures are seldom necessary. See Pear.

Black rot, *Physalospora malorum.* Black rot appears on the maturing fruit as a hard brown rot on the surface of which appear concentric rings of minute black pustules. This rot eventually involves the entire fruit which then turns coal black and shrivels to a hard mummy. Foliage infection shows as small circular brown spots scattered over the leaf suggesting the common name of "frog-eye." Severe infection may cause defoliation. The fungus also causes shallow cankers on the branches. Spores from the mummied apples and the branch cankers are washed by rain onto the foliage in the spring before bloom. One or two sprays with Dichlone at this time will control the disease for the season.

Figure 5. Black rot—mummied apple.

Brooks spot, fruit speck, *Mycosphaerella pomi.* Small irregular black specks on the skin of the fruit characterize this disease. These spots are characteristically on the calyx end of the apple. Infection takes place from June 10 to mid-July but the specking of the fruit may not show until picking time. The regular spray schedule usually controls this trouble, but if special sprays are necessary use two sprays of ferbam or thiram during the infection period.

Sooty blotch, *Gloeodes pomigena.* As the common name suggests this disease is characterized by circular sooty-black blotches on the skin of the apples. As with fruit speck the infection period is in early summer but the blotches are not evident until near harvest time. The fungus grows entirely on the surface and in fact before the advent of orchard spraying, washing them off with weak vinegar was advocated. The usual spray schedule with a fungicide gives complete control.

Fly speck, *Microthyriella rubi.* As the common name implies, this fungus produces minute black specks identically like fly specks on apple fruit. These specks are congregated in circular areas on the skin of the fruit. The time of infection and control are the same as for sooty blotch. And like sooty blotch it is only a skin blemish, not affecting the flesh at all.

Bitter rot, *Gloeosporium rufomaculans.* A hard, light brown fruit rot, circular in outline is characteristic of this disease. These rotted areas eventually become black, sunken,

and covered with more or less concentric rings of pink, glutinous spore masses. The fungus also causes indistinct cankers on the branches, which serve as reservoirs of inoculum for fruit infection. This disease is relatively rare in Connecticut and the regular spray schedule controls it.

Brown rot, *Monilia cinerea.* This fungus, most commonly found on stone fruits, may cause a rot of ripe apples. Early varieties are most commonly affected. The usual spray schedule gives ample protection.

Powdery mildew, *Podosphaera leucotricha.* This fungus produces a superficial, white powdery growth on the foliage and immature twig growth of apple. In severe cases the leaves and young stems are stunted and distorted. The causal fungus overwinters in the vegetative stage under the bud scales and on the twigs. The fungus starts growth when the buds start, but as it requires high temperatures and a minimum of moisture for optimum growth, it does not become apparent until the hot dry summer weather. Heretofore it has not been an important disease of bearing trees in Connecticut, occurring mostly on nursery stock and sporadically on young trees. As it is a sulfur-sensitive fungus we can postulate that its increase in bearing orchards is due to the omission of sulfur from spray schedules and that the substituted materials are not effective. Sulfur added to the prepink and pink sprays should give the necessary control.

Cedar-apple rust, *Gymnosporangium juniperae-virginiana.* This fungus is a heteroecious rust having one stage of its life cycle on the apple and the other on red cedar. From this dual existence derives its common name, cedar-apple rust. On the cedar are produced the well-known cedar apples. These are in reality fleshy galls on the surface of which are produced bright orange gelatinous horns during rainy periods. On these horns are produced spores which are blown by the wind to apple trees, there causing bright orange spots on the foliage and to a lesser degree on fruit. The infections on apple foliage produce another spore stage, borne in delicate cup-like structures which reinfect the cedar and thus the cycle is complete. A related fungus, quince rust, *Gymnosporangium clavipes* infects the fruit of Cortland, causing a hard green lesion on the calyx end. Spraying with ferbam during May and early June will control both of these rusts.

Baldwin spot or bitter pit. This trouble is characterized by brown corky flecks in the flesh of the fruit. The flecks are most frequently found just under the skin of the apple but may be scattered through the flesh extending as far as the core. Baldwin spot differs from drought spot in that the spots are sharply defined whereas drought spot is a solid browning of the affected tissue. The bitter flavor of the corky tissue gives the name bitter pit. It is definitely known that this trouble is not caused by an organism, but extensive investigation has so far failed to establish the exact cause. The best thought suggests that it is a nutritional disease, possibly the ratio of calcium to other components of the fruit, coupled with certain moisture and temperature factors. Baldwin, Greening and Northern Spy are the more susceptible varieties; the McIntosh group is rarely affected. No control is known.

Drought spot. A physiological trouble due to boron deficiency accentuated by drought conditions. The fruit has brown corky areas in the flesh around the core, which in severe cases extend to the outside causing cracking and distortion. Eventually the new growth fails to develop the side buds, resulting in naked twigs with tufts of foliage at the tips. One-half pound of borax per tree every 3 years will correct the trouble.

Manganese toxicity. The uptake of excess manganese from very acid soils results in watery blisters in the outer bark of the trunk, which do not penetrate to the cambium. Usually these blisters burst and the contents, a brown liquid, streaks down the bark. Manganese toxicity in itself is not injurious to the tree, but the low pH it indicates leads to reduced growth and yield. The obvious control is to raise the pH of the soil.

Water core. This trouble shows as translucent areas in the flesh of the apple, which may be confined to the flesh around the core or may encompass the entire fruit giving it a characteristic glassy look. Fruit affected with water core is heavier and harder than normal apples and the normal flavor is masked by a sweet syrupy flavor. No organism has been found associated with water core and the omnibus term of physiological trouble must be advanced as the cause. King and Fall Pippin are particularly prone to this

trouble, but the common commercial varieties in current use are rarely affected.

Storage scald. The scalding of apples in storage or after being taken out is a breaking down of the tissue due to absorbtion of volatile compounds given off by the fruit itself in the normal respiration processes incidental to the ripening of the fruit. There are no pathogenic organisms concerned in the initial injury although numerous organisms may later be present in the scalded tissue. This trouble may manifest itself in two ways, a browning of the skin of the fruit in varying patterns and a complete breakdown of the flesh, resembling a baked apple. Commonly these two forms are called hard and soft scald. Oil-paper wraps and controlled air storage have successfully controlled scald where control measures are necessary. However, if the fruit is not too green when stored and proper attention is paid to temperature and humidity control, scald will probably not be a problem.

Weather. Under this title will be considered the more common tree and fruit injuries caused by various weather conditions.

Sun scorch on fruit occurs on the apples on the south side of the tree and on the side exposed to the sun. Air temperatures above 90°F. coupled with low humidity are necessary for sun scorch. The injury shows as circular areas varying in color from a pale yellow through buff to brown. In extreme cases the areas are flattened and black with a light halo. Foliage scorch as a direct result of high temperatures is less common and shows as irregular light-brown areas. Heavy deposits of sulfur on fruit or foliage increase the damage on both fruit and foliage. Sunburn of the bark on large branches frequently results when old trees are heavily pruned and branches, for a long time protected from the direct rays of the sun, are exposed. Obviously this injury is confined to the upper side of the branch. The burning results in varying degrees of injury from a roughening of the bark to a complete killing of large areas. Wood-rotting fungi enter through these dead areas and loss of entire branches may eventually result.

Prolonged winter temperatures below -10°F. will kill the bark and cambium on the lower side of apple branches nearest the ground. Trees which have borne a heavy crop of fruit the preceding summer are most likely to be injured by low temperatures. In both cases the lack of stored carbohydrates in the wood is the controlling factor. There is less carbohydrate storage in the underside of the branch and the tree that had a full crop of apples is low in stored carbohydrates. Late frosts may cause foliage injury and fruit russetting. The effect of frost on young leaves is to stop the growth on the lower side of the leaf causing a downward cupping and a loosening of the lower epidermis, which will be stretched across the cupped leaf like a drum head. Fruit russetting may appear as a random pattern of russet or it may be in the form of equatorial bands or a random pattern of arcs of circles.

Hail injury, if severe enough, is immediately apparent and recognizable but a slight bruising may not be evident until picking time. The chief diagnostic character would be the location of the injury on the upper and outer surfaces of the fruit. Like hail injury on the fruit, severe twig injury is at once apparent but slight injury will not show until next year when a series of sunken eye-shaped spots will appear on the upper side of the twigs. These spots will show for several years until entirely covered by new growth.

Spray injury. With the wide diversity of materials and combinations of materials which may be used as sprays and the equally wide diversity of weather conditions under which they may be applied, it is an occupation of little value to try to describe the injuries that might occur. Perhaps all one can say is that all spray injuries have two characteristics in common. They usually appear over a wide area at once and while the injury may increase in severity with time, it does not spread with time to trees or parts of trees originally free of injury.

Apple curculio, *Tachypterellus quadrigibbus.* This is a snout beetle, smaller than the plum curculio. It injures the fruit by feeding on the young fruit but does not make crescent-shaped feeding marks. There is one generation a year. Adults emerge from hibernation in the spring and deposit eggs in the small apples. The larvae complete development about the middle of August and pupate in the soil. The beetles emerge in late summer and fall and hibernate. Damage is entirely from fruit punctures. Repeated spraying with lead arsenate, or possibly

methoxychlor, during the egg-laying season has controlled this pest.

Apple leaf-curling midge, *Dasyneura mali.* The parent insect is a minute fly and the young are orange-colored maggots living in the edges of curled leaves. The principal damage is to rapidly growing shoots on young trees. It is not a serious pest in Connecticut. It may be killed by an application of DDT, nicotine, or malathion at the petal fall stage of growth.

Figure 6. Work of apple and thorn skeletonizer.

Apple and thorn skeletonizer, *Anthophila pariana.* The larvae are pale yellowish green with black spots and a brown head. The moth is brown in color with a purplish tinge and has a wing spread of half an inch. The larvae skeletonize the leaves, living under a flat web (See figure 6). There are three generations a year. This pest may cause severe damage, but has seldom been abundant in the past 20 years. If needed, sprays of lead arsenate or DDT will control this pest.

Apple maggot, *Rhagoletis pomonella.* This pest is also called the apple fruit fly or railroad worm. The adult insect is a small fly about the size of a house fly, with wings marked with bars, and a small white dorsal spot. Eggs are laid on the fruit and the small legless maggots tunnel in the flesh of the apple. The overwintering stage is a seed-like puparium in the soil. There is only one generation a year. Flies emerge from June 15 to August 15. Egg-laying usually reaches a peak early in August, but may continue until the apples are harvested. Keeping the trees sprayed with lead arsenate or DDT from July until September has controlled the pest. Control is especially difficult in rainy seasons, or when flies migrate into the orchard.

Figure 7. Injury caused by apple red bug.

Apple red bug, *Lygidea mendax.* Red bugs are active insects about one-fourth of an inch long, with bright red markings on the margins of the wings. They winter in the egg, which is inserted in bark lenticels of small twigs. Hatching takes place before blossoming, and the bugs mature in June and lay eggs which hatch the following spring. Feeding on terminal leaves results in distortion. Feeding on fruit produces a dimple or a series of small russet scars. (See figure 7). In our tests DDT or malathion have been effective when applied as soon as the petals fall.

Buffalo treehopper, *Ceresa bubalus.* These are green hoppers with a heavy spine on each shoulder. The damage is chiefly from egg punctures in the bark of young trees. If the infestation is severe, the tree may be stunted. There is one generation a year, and the winter is passed in the egg stage. The nymphs hatch in spring, drop to the ground and feed on such plants as alfalfa and bindweed. Adults develop about July 15, and egg laying in apple twigs starts about August 1. Avoiding alfalfa cover crops and keeping bindweed out of young orchards will help prevent injury. In commercial orchards, spraying will give some relief, especially if weeds are also sprayed.

Cankerworms, *Alsophila pometaria.* These are small striped "measuring" worms,

black or greenish in color. They hatch from eggs laid on the tree in late fall or early spring. The male moths are gray with a wing spread of about one inch. The female moths are wingless. There is one generation a year. This pest may cause severe damage, defoliating the trees early in the season. It occurs in cycles, however, and only a few are seen in some seasons. A single spray of lead arsenate or DDT applied as soon as feeding starts controls this pest.

Figure 8. Cankerworms

Casebearers. The cigar casebearer, *Coleophora fletcherella,* and the pistol casebearer, *Coleophora malivorella,* feed on apple leaves. The larvae live in small silken cocoons about one-fourth of an inch long attached to the surface of the leaf. The feeding spot is at first transparent and later the dead tissue drops out leaving a hole. The adult moths are small and inconspicuous. Casebearers usually cause only slight damage although outbreaks may occur. Pre-blossom sprays of lead arsenate or DDT will control them.

Clover mite, *Bryobia praetiosa.* As the name indicates, these mites develop on clover or grass underneath the trees, and migrate to apple foliage in spring or fall. They are minute flat-topped creatures with small scales around the margins of the body. Eggs are spherical in shape and dark red in color. They are deposited either on twigs or under bark scales near the ground. There are several generations a year, but apples are infested mostly in spring or fall. There may be two species, one feeding on grass and the other on clover. Damage usually consists of leaf stippling, similar to that caused by European red mite, premature yellowing of the foliage and early loss of leaves. Sprays of aramite or phosphate miticides control this pest.

Figure 9. Codling moth.

Codling moth, *Carpocapsa pomonella.* The larva of this insect feeds in apples. It is distinguished from other caterpillars by the distinct spots, and by the habit of tunneling directly to the core of the apple. The moths are slightly more than one-fourth of an inch long, gray to brown in appearance, with wavy lines and a dark band at the tips of the wings. There are two generations a year. The first enters the fruit shortly after the blossoms fall. The second begins in August and continues into September. Damage varies a great deal from year to year. Cool nights during flight of moths reduces infestation. Infested apples are usually unfit for sale. (See figure 9). Sprays of DDT or lead arsenate applied when the eggs are hatching control this pest.

Comstock mealybug, *Pseudococcus comstocki.* This bug is flat with a pinkish body covered with a woolly secretion, and with a long tail. It is sometimes confused with the woolly aphid. It feeds by sucking sap from the plant. The winter is passed in the egg stage on the trees. The young hatch late in May or early June. They mature in a month or 6 weeks and lay eggs. This generation matures in September or October and deposits eggs which live over the winter. Heavy infestations reduce the vigor of trees. The most effective spray has been DDT applied either early in June or early in August, or at both times if necessary.

Eastern tent caterpillar, *Malacosoma americana.* These are hairy caterpillars that build silken tents in which they hide except when feeding. (See figure 10). The adult is a medium-sized moth which lays eggs in masses attached to small twigs. There is only one generation a year. Overwintering eggs hatch very early in the spring, and moths fly late in June. This pest occurs in definite

cycles, with a severe outbreak every 7 or 8 years. The cycles are the result of parasitism, or disease. Damage may vary from none to complete defoliation of trees. Control is easily obtained by spraying with lead arsenate or DDT as soon as small tents are seen.

Figure 10. Eastern tent caterpillar on apple.

European apple sawfly, *Hoplocampa testudinea.* This larva is easily recognized by the numerous transverse lines and the general shape of the head and body. The adult is a clear-winged sawfly a little larger than the house fly. The larvae feed in the fruit just below the skin until about one-third grown, and then start boring directly through the fruit. (See figure 14). They sometimes pass from one small apple to another, leaving a chocolate colored "sawdust" on the surface. The winter is passed in the soil as a mature larva. Pupation occurs late in the spring and the sawflies appear at about the time the trees blossom. Eggs are laid in the flesh of the calyx cup, and the young larvae feed there before beginning to tunnel. Dieldrin sprays applied just before the blossoms appear and again as soon as the petals fall control these sawflies.

European red mite, *Metatetranychus ulmi.* The mature mites are very small and best seen using a magnifier. The adult female is dark red with white spots. Other stages vary from red to green in color. Eggs laid in summer are brown, and those that pass the winter are red. They are slightly flattened and have a delicate central hair. The winter is passed in the egg stage on the bark of the trees. There are several generations each summer, and the peak of infestation usually occurs in July or early in August. Feeding of the mites causes bronzed foliage which may drop prematurely. Fruit from such trees is likely to be small. The "superior type" of dormant oil sprays may be applied in early spring before trees start growing to kill the overwintering eggs. Summer sprays of Aramite and Ovotran are among the effective materials for application to foliage.

Eye-spotted bud moth, *Spilonota ocellana.* The caterpillar is brown and feeds on the lower surface of the leaf in a sort of mine. The mine usually contains black specks, which distinguish it from mines of the red-banded leafroller. Damage is usually seen in midsummer. The adult moth is brownish with a white band. The larvae not only mine the leaves but also feed on the fruit, especially beneath a leaf resting on an apple. In the spring the overwintering caterpillar may bore into fruit buds. Control measures consist of dormant sprays of dinoseb (formulation DN-289), or summer applications of lead arsenate and nicotine sulfate.

Fall webworm, *Hyphantria cunea.* This insect builds a loosely constructed tent on the ends of infested branches. It appears late in the summer, and has been most abundant in the northeastern part of the state. Damage is usually not extensive. The usual summer foliage sprays have controlled this insect.

Flatheaded apple tree borer, *Chrysobothris femorata.* As the name indicates, this borer has a distinctly flattened thorax. It feeds under the bark, usually curled in a U-shaped pattern. The feeding tunnels show through the bark as sunken areas. The adult is a brown beetle. There is one generation a year. Eggs are laid in cracks in the trunk on the sunny side of the tree. The winter is passed in the tunnels. This borer usually attacks trees in poor condition and occasionally girdles them. Shading the trunks of trees has helped prevent attack. Studies on chemical control are not complete, but spraying the bark of trees with DDT has helped control related borers on other trees.

Fruit tree leaf roller, *Archips argyrospila.* The principal damage is done by feeding of larvae on fruit clusters. The larvae are small green caterpillars with black heads. Eggs are laid in compact masses on the bark, and turn white over the winter. Hatching takes place at the pink stage. Eggs are laid about July 1, and remain over the winter. Dormant oil

sprays are helpful in killing the overwintering eggs. Sprays of DDT or lead arsenate starting at the pink stage have controlled larvae in our tests.

Figure 11. Gypsy moth.

Gypsy moth, *Porthetria dispar.* Apple is one of the preferred hosts of this pest. Eggs are laid in masses on the bark, pass the winter, and hatch early in the spring. The larvae are 2 to 3 inches long when fully grown, and dark gray in color with prominent hairs. The moths appear in midsummer. There is one generation a year. This pest is seldom a problem in orchards that are sprayed. Orchards surrounded by heavily infested woodlands may suffer severe damage from migrating larvae. Sprays of lead arsenate or DDT have controlled this pest. Spraying the margins of heavily infested woodlands helps protect orchards.

Figure 12. Apple aphid.

Apple aphid, *Aphis pomi.* This is a small green aphid which attacks water sprouts and rapidly growing terminals at first, later infesting the entire tree if unchecked. The eggs are elongate, shiny and black, and are laid in the fall on the bark. (See figure 12). In the spring the eggs hatch and the aphids start feeding. There are many generations which produce living young. In the fall males and females appear and eggs are deposited. The damage is chiefly to the foliage, but feeding on young apples deforms them. Heavy fertilization with nitrates results in an increase of these aphids. Dormant sprays to kill the eggs have not been of much benefit because of migration. Control by spraying is difficult because of the potentiality for rapid reproduction. Repeated sprays of malathion have given good results in tests.

Green fruitworm, *Lithophane antennata.* These are large green loopers, marked with longitudinal white stripes. They often feed on young fruit in May and June. These worms are controlled by the usual apple sprays applied just before and just after bloom.

Japanese leafhoppers, *Orientus ishidae.* These leafhoppers start their feeding on water sprouts and later spread throughout the tree. The mature hoppers are about one-fifth of an inch long, and dark gray in color, with a mottled appearance. The winter is probably passed in the egg stage near the base of the trunk. Hatching may occur from May 21 until June. The nymphs feed until about August 1. Adults appear from August into September. Feeding of nymphs and adults may kill triangular areas of infested leaves. Removal of water sprouts early in the season helps to reduce the infestation. Sprays of DDT have killed nymphs and adults in spray tests.

Leaf crumpler, *Mineola indigenella.* This insect feeds in black, twisted, horn-like tubes, first on the twig and on the leaves as soon as they develop. The larvae mature in May and small moths with brown and white markings emerge two weeks later. Damage is sometimes severe on young trees. Spraying with lead arsenate has controlled this insect.

Leaf miners. At least three species of leaf miners attack apples. These are the spotted tentiform leaf miner, *Lithocolletis* sp., the unspotted tentiform leaf miner, *Callisto gemitella,* and the leaf trumpet miner, *Tischeria malifoliella.* They all make

blotch mines by eating the contents of the leaves between the upper and lower surfaces. Damage is usually slight, but heavy infestations affect the vigor of the trees. There are two or three broods a year. If control is necessary, sprays of DDT are effective.

Leopard moth, *Zeuzera pyrina.* The large spotted caterpillar bores in the larger branches of the trees. The damage is usually breakage of limbs. The insect requires two years to complete its life cycle. The only remedy known is to cut off and burn infested branches. The insect is scarce in Connecticut, and the regular spray schedules may be controlling it. (See figure 56).

Lesser appleworm, *Grapholitha prunivora.* This is a small pinkish larva which feeds just beneath the skin of the apple. The adult is an inconspicuous small moth. There are believed to be two broods a year. Sprays used to control the codling moth also control this worm.

New York weevil, *Ithycerus noveboracensis.* This is a large gray weevil one-half to three-fourths of an inch long. It feeds on the bark. No control is necessary.

Oriental fruit moth, *Grapholitha molesta.* This pest of peaches may also feed on apple fruit. It differs from the codling moth in that it does not tunnel in to the core. There are three generations a year. Special sprays are usually not needed on apples. See Peach.

Figure 13. Oystershell scale.

Oystershell scale, *Lepidosaphes ulmi.* This scale is elongate and enlarged at one end. (See figure 13). It winters in the egg stage. These hatch late in May and crawl about before settling down on the bark. They mature late in the summer, and eggs are laid under the scale. This scale may kill branches of heavily infested trees. Spraying with DDT early in June has killed the crawlers.

Palmerworm, *Dichomeris ligulella.* This larva is olive green, with two lateral and two dorsal white stripes. The moth appears in July and hibernates over the winter. This insect has not been abundant in recent years, and control has not been required.

Pear leaf blister mite. See Pear.

Periodical cicada, *Magicicada septendecim.* The adult is about 1½ inches long, with membranous wings. Eggs are laid in twigs and the young nymphs drop to the ground. They feed on roots for 17 years. The damage is mostly from egg laying, which may kill twigs and even small branches. In some cases feeding of the nymphs has seriously damaged roots. Adults may be killed by frequent application of phosphate sprays. Work on control of nymphs is now underway.

Plum curculio, *Conotrachelus nenuphar.* This is a small dark-brown snout beetle with humps on the wing covers. Overwintering adults damage young fruit by feeding and by inserting eggs in crescent-shaped feeding areas in the skin of the fruit. The legless larvae feed in the apple. Infested fruit either falls to the ground or the larvae dies and the apple is deformed. (See figure 116). There is only one generation a year. Egg laying starts soon after the petals fall and may continue for a long time. This is one of the very serious pests of apples. Sprays of lead arsenate or methoxychlor applied regularly from petal fall until July 1 have been effective in spray tests.

Potato leafhopper, *Empoasca fabae.* This is a small green leafhopper which sometimes feeds freely on young apple trees. A spray of DDT has controlled this pest.

Red-banded leaf roller, *Argyrotaenia velutinana.* The moth has a red band across the wings. The larva is green with a brown head and mines on the under surface of the leaves. It may also feed on the skin of the fruit. There are two generations a year. The first hatches in the spring from scale-like patches of eggs laid on the bark in the fall, and the second from July to September from eggs laid on leaves. This later generation may continue to feed on fruit in storage. Sprays of lead arsenate or TDE may be applied to control either generation. (See figure 14).

Red-humped caterpillar, *Schizura concinna.* This is a spring caterpillar with a

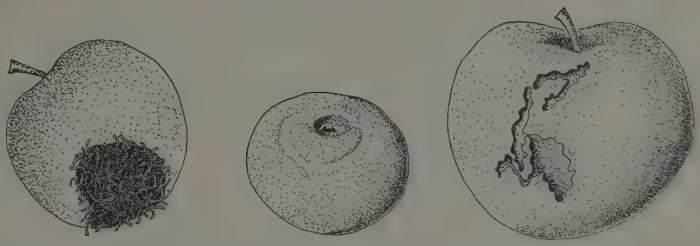

Figure 14. Injury to apple from *Roestelia pyrata* (left), sawfly (center), and red-banded leaf roller (right).

red hump, usually feeding in clusters. It feeds usually with the tail elevated. There is one generation a year. Damage is entirely from leaf feeding. If abundant, sprays of lead arsenate or DDT can be used for control.

Red spider mite, *Tetranychus telarius.* This small mite is also known as the two-spotted mite because of a dark spot on either side of the body. It winters in the adult stage on or under bark scales, losing the spots and becoming pink. The young feed first on cover crops, and move up the tree as the season progresses. Damage consists of brown foliage and reaches a peak about August 15. Summer sprays of Aramite, Ovotran (ovex), or malathion have killed these mites.

Rodent or mouse injury. Meadow mice and pine mice damage apple trees in Connecticut. The meadow mice feed on the trunks of trees at the ground level and may girdle trees. Pine mice feed on roots, and the injury is more difficult to find. Young trees have been protected from meadow mice by wire guards. Poisons such as zinc phosphide mixed with dried apples and placed in runways have been reasonably effective.

Rose chafer. This pest of peaches, roses and grapes may feed on apples. See Rose.

Rosy apple aphid, *Anuraphis roseus.* This is a pink aphid with enormous capacity for reproduction. Winter is passed in the egg stage on apple twigs. Eggs start hatching late in April and the aphids feed on apple foliage and fruit until about July 1. They migrate to plantain until fall, when they return to apples and lay their shiny black eggs. Results of feeding are curled leaves and deformed fruit. Damage to the fruit may be severe. Dormant DN sprays have killed the overwintering eggs. Malathion sprays applied frequently before the petals fall have controlled the spring infestation.

Roundheaded apple tree borer, *Saperda candida.* This borer tunnels deeply in the trunk of the tree. Three years are usually required for development. The adult is a slender long-horned beetle, gray with two conspicuous longitudinal white stripes. (See figure 15). Infestation may weaken or girdle a tree. Lead arsenate sprays applied to the trunk and surrounding weeds about 2 weeks after petal fall and 3 weeks later have controlled this borer.

Figure 15. Roundheaded apple tree borer.

San Jose scale, *Aspidiotus perniciosus.* This scale is circular, passing the winter as an adult on the barks. Young crawlers appear in June, and a second generation in August. Scales feeding on fruit produce red spots. This scale is capable of killing trees. Dormant oil sprays have given satisfactory control.

Scurfy scale, *Chionaspis furfura.* Scurfy scale is white and elongate. The eggs are purple and live over the winter, hatching in May. There is one generation a year. The winter eggs have been killed by dormant oil sprays.

Shot-hole borer, *Scolytus rugulosus.* These small dark beetles leave small exit holes as they emerge from infested trees. Eggs are laid on weak trees, and the larvae feed just beneath the bark. Vigorous trees are seldom infested. See Peach.

Spotted apple tree borer, *Saperda cretata.* The borer looks like the roundheaded borer. The adult is spotted. See roundheaded borer.

Tarnished plant bug, *Lygus pratensis.* This bug is a general feeder. It may cause dimpled fruit, but is usually not a serious pest of apples. See Celery.

Tussock moths. The white-marked tussock and the hickory tussock moth feed on apple. See Horsechestnut and Hickory.

White apple leafhopper, *Typhlocyba pomaria.* This is a small active white leafhopper about one-eighth of an inch long. The nymphs may be greenish or yellowish and feed on the under surface of the leaves. Eggs pass the winter in the bark of twigs and hatch in May. A second generation develops from August to October. Feeding on the leaves removes chlorophyll, leaving spotted or white foliage. Adults may feed on fruit causing spots. In addition, mature fruit may be soiled by excrement. Sprays of DDT, methoxychlor, or malathion have controlled these leafhoppers.

Woolly apple aphid, *Eriosoma lanigerum.* These aphids are covered with a woolly mass. They feed on scars on the trunks or branches. They spend the winter on elm trees and migrate to apples in June. Apple trees, and particular newly planted young trees, may be seriously damaged by aphids feeding on roots. Malathion sprays have controlled these aphids or branches.

Yellow-necked caterpillar, *Datana ministra.* This caterpillar is closely related to the red-humped species and the same control applies.

Yellow mite, *Eotetranychus uncatus.* This species is similar to the red spider mite except that it is smaller and yellow. See red spider mite.

Araucaria

Mealybug. Whitish, dusty-appearing bugs in the axils of leaves and branches suck the sap and often cause considerable injury. See Lantana.

Arborvitae (Thuja)

Winter injury. A browning of the previous season's growth often shows on arborvitae, pine, and junipers in late winter or early spring due to drying winds or hot sun. Trees in exposed locations are more severely affected. This discoloration is due to evaporation of moisture from the leaves or needles faster than the roots can pick up water and is very apt to occur on newly transplanted trees. Mulching and a thorough soaking of the ground around the trees before the ground freezes will help. Planting evergreens in protected places will prevent such drying. This reddish-brown discoloration of the tips of the branches should not be confused with the browning and dropping of the leaves or needles on the inside of the tree nearest the trunk. This leaf fall may take place in spring or fall and is a natural shedding of old leaves. Individual trees vary in this natural leaf-shedding: in some it may take place every year; in others every second or third year.

Aphids, *Cinara tujafilina.* Aphids feed in colonies, sucking the sap from the plant. The insects are brown and about one-eighth inch long. Malathion or nicotine sulfate sprays will control them.

Bagworm, *Thyridopteryx ephemeraeformis.* The caterpillar lives in a silken cocoon or bag. Bits of leaves are attached to the outside of the bag. The caterpillar carries the bag with it as it feeds. A fully developed bag is about 2 inches long. Eggs are laid in the fall and hatch in May or June of the following year. Lead arsenate or malathion applied soon after hatching has controlled this pest.

Arborvitae leaf miner, *Argyresthia thuiella.* The small greenish larva of this moth is a miner in the narrow leaflets of arborvitae, and passes the winter in the mines. The injured leaves turn brown. The light-gray moths emerge the last week of May and

the first part of June, and lay eggs on the leaves. These eggs hatch about June 20 and the larvae begin mining the leaves. There is one generation each year. Shaded plants are more heavily infested. DDT or malathion spray applied about June 1 and again June 15 has killed moths and young larvae before they start mines.

Arborvitae soft scale. This is a small brown hemispherical scale occurring on arborvitae. It has been found in Connecticut in a few localities. Malathion sprays applied early in May or during August have given good control. See Bulletin 578.

Red cedar bark beetle. See Juniper.

Spruce mite. See Spruce.

Strawberry root weevil. See Hemlock.

Ash

Rust, *Puccinia peridermiospora.* Raised crescent-shaped or irregular swellings on leaves or petioles burst open, releasing an orange powder. By the time infection is noted, it is too late to apply a preventive spray. The infection will not spread on ash but goes to a marsh grass *(Spartina* sp.*)* which produces spores the following spring to infect ash. Control measures are not suggested since the infection appears to do little harm to the tree.

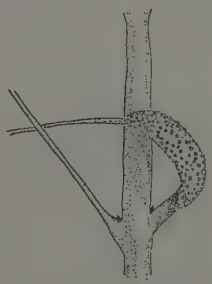

Figure 16. Ash rust.

Leaf blotch, *Gloeosporium aridum.* Irregular brown blotches appear in midsummer on leaves in wet seasons, and leaves may fall. *Phyllosticta fraxinicola* makes small yellow spots in late summer, and some years *Piggotia fraxini* causes an epidemic of small purple spots with yellow borders. Burning of fallen leaves removes much of the source of inoculum for the following year for all three diseases. Spraying with ferbam, Bordeaux, or thiram plus a spreader when leaves are half grown and again when full grown will give adequate control

Ash flower gall, *Eriophyes fraxiniflora.* This mite causes a distortion of the staminate flowers of white ash, forming bunches or masses from one-fourth to three-fourths inch in diameter. These masses finally dry and remain on the tree over the following winter. Dormant sprays of miscible oils are said to prevent this development.

Ash sawfly, *Tomostethus bardus.* Occasionally the leaves of white and green ash are devoured in May and June by greenish white sawfly larvae, which reach a length of nearly three-quarters of an inch. The color is pale greenish white, with a darker green median stripe, and with black head and legs. Spraying with lead arsenate or DDT has controlled them.

Fall webworm. See Pear.

Lilac borer, *Podosesia syringae.* Rough swellings on the limbs and branches, in addition to breakage of branches at the point of injury, indicates the presence of the pest. The insect is white in color with a brown head and is about three-quarters inch long. The clear-winged moths lay their eggs in May and June. Winter is passed in the larval stage under the bark. Good control may be expected when a mixture of 1 pound of paradichlorobenzene crystals dissolved in 2 quarts of cottonseed oil is painted on the bark wherever sawdust or sap appear. Best results have been obtained in the fall or spring. DDT sprayed or painted on the bark has killed the moths when treatment was made in late April and repeated in 2 or 3 weeks.

Oystershell scale. Malathion spray has given good control of the young crawlers when applied about June 15. Bulletin 578 contains the details.

Scurfy scale. See Pear.

Asparagus

Rust, *Puccinia asparagi.* This fungus disease appears as dusty reddish-brown spots on the leaves and stems. Later these spots take on a darker appearance and become more firm. This disease has been eliminated in Connecticut by the use of rust-resistant asparagus varieties. Recently rust has been reported on these same varieties growing in other states. It is possible that rust may reappear here.

Figure 17. Asparagus rust.

If it does, it may become necessary to choose only the most resistant varieties, and perhaps to spray with fungicides which are not needed now.

Asparagus miner, *Melanagromyza simplex.* This insect mines or tunnels near the base of the stem and just beneath the epidermis. Some of the mines start a foot or more above the soil and the miners work downward, often beneath the surface. The adult is a two-winged fly that emerges during the first week in June, and there are two generations each season. The insect passes the winter in the burrow, in the form of a pupa resembling a flax seed. Control is not usually necessary. Pulling and burning old stalks in late fall, however, will destroy the overwintering puparia.

Figure 18. Asparagus beetle.

Common asparagus beetle, *Crioceris asparagi.* This is a bluish-black beetle with three whitish spots and an orange outer margin and tip on each wing cover. The thorax is reddish and usually bears two black spots. This beetle is about one-fourth of an inch in length and hibernates under rubbish, bark of trees, or similar situations where it can find shelter. Emerging from winter quarters at the time the shoots appear, the beetles eat the tender shoots, often causing considerable injury. The females lay eggs that are fastened vertically upon the shoots, but later in the season place them upon the leaves and flower stems. The grubs that hatch from the eggs are gray with black legs and head, and feed voraciously upon the leaves, the epidermis of the stalks, and damage the shoots near the end of the cutting season. New plantations must be protected as defoliation weakens the plants. Control by dusting with rotenone or pyrethrum during the cutting and using DDT after the cutting season.

Spotted asparagus beetle, *Crioceris duodecimpunctata.* The spotted asparagus beetle is slightly larger than the common asparagus beetle. It is reddish brown or orange in color, and has six black spots on each wing-cover. The beetles feed on the tender shoots with the common asparagus beetles. Use same control as for the common asparagus beetle.

Aster (Cl.ina)

Wilt, *Fusarium oxysporum f. callistephi.* Aster wilt is the most troublesome disease of china aster. Plants may be attacked any time: young plants dry up suddenly or older plants show first a pale green color accompanied by wilting of lower leaves on one side of the plant followed by death of the entire plant. Wilting may show first in the middle of the day, but the plant seems to recover at night. Some plants may show no signs of infection until they come into flower, when they collapse suddenly. When the stem is cut, a brown discoloration shows in the vascular ring. Roots are usually well rotted. A pink mass of fungus spores may or may not show on the main stem just above or below ground level.

Control is difficult. The disease is carried both on the seed and in the soil. Soaking seeds 5 minutes in a 5 per cent formaldehyde solution or 30 minutes in a 1:1000 corrosive sublimate (see p. 78) and rinsing before planting will help. Careful handling of plants will avoid root injury which enables the fungus to enter the plant. Since repeated cropping of the same area greatly increases the amount of disease, rotation is essential. Soil sterilization with steam or formaldehyde is advisable if rotation cannot be practiced (see p. 4).

Use of wilt-resistant varieties is only a

partial solution since there are several strains of the wilt fungus, and no one variety is resistant to all the strains.

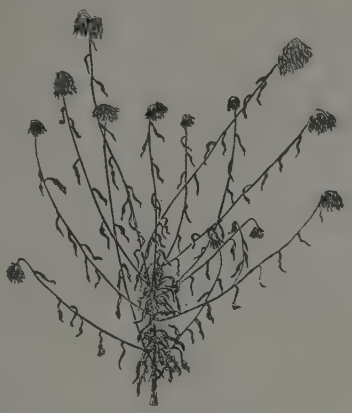

Figure 19. Aster wilt.

Yellows. Virus. The symptoms consist of a yellowing or clearing of the veins in newly infected leaves, shortening of the internodes of the main stem and production of long axillary breaks, creating a witches'-broom, usually yellowish in color. If plants are infected young, they remain stunted, and if flowers are produced, they are small and green. Symptoms do not always appear on the entire plant, but may show on only one stalk, depending on the time of infection. This virus is transmitted by leafhoppers. Since it infects a great many plants (daisies, chrysanthemums, plaintain, and dandelions being but a few of the perennial hosts), the asters may become infected from perennial weeds nearby. Roguing of diseased plants and leafhopper control are essential. Mowing a 6-foot strip around the field and spraying this area with DDT will help. Infection has also been reduced 50 per cent by growing asters under cloth screens 5 feet high.

Rust, *Coleosporium solidaginis.* Aster leaves develop pustules on the underside which shed an orange-red powder. These spores spread the disease further on asters. The alternate hosts are the 2- and 3-needle pines on which are developed spores that infect aster and goldenrod leaves. The aster stage can overwinter on wild aster and goldenrods to reinfect cultivated asters the following season, so that pines are not necessary to the dissemination of the fungus. Ferbam or zineb sprays starting in mid-June before infection has occurred can keep aster foliage clean. Applications made immediately upon noticing infection should help limit its spread.

Grey mold, *Botrytis cinerea.* This fungus usually attacks white or light-colored flowers, showing first as a petal spot and quickly rotting the entire flower. Leaves and stems may be involved and covered with a dirty grey mold. Cool, wet weather favors development and spread of the fungus. No fungicide spray gives good control, but a change to sunny weather will stop the disease. Also improved ventilation and lessened humidity help.

Powdery mildew, *Erysiphe cichoracearum.* A whitish dust or bloom appears on leaves, and flowers become dull colored. This fungus is encouraged by hot, dry conditions. Spraying or dusting in the afternoon with sulfur will control it.

Figure 20. Aster yellows.

Foliar nematodes, *Aphelenchoides ritzema-bosi.* Lower leaves first show brown wedge-shaped areas between the veins which eventually involve the entire leaf. Discoloration progresses from the bottom of the plant up. This nematode is the same eelworm that affects garden chrysanthemums, and infestation of asters resembles mum infection. Susceptible plants should not be planted following each other unless soil has been ster-

ilized. This includes asters, chrysanthemums, calendula, dahlias, scabiosa, and many other composites.

Figure 21. Black blister beetle on aster.

Blister beetles, *Epicauta* sp. Aster flowers are frequently devoured by the black blister beetle, (see figure 21), occasionally by the margined blister beetle, and rarely by two or three other species, the gray blister beetle, and the ash-gray blister beetle. Sprays of lindane or DDT applied as soon as these beetles start feeding have controlled this pest.

Grubs. Grubs of Japanese beetle, Asiatic garden beetle, etc., when abundant, may feed on the roots of asters, causing a weakening of the plants. See Lawns.

Leaf miners. The leaves of aster are sometimes infested by miners that make narrow serpentine mines *(Phytomyza albiceps)*, or blotch mines *(Agromyza platyptera* and *A. posticata)*. Eggs are laid in the leaves by tiny flies. If abundant enough to justify control, sprays of lindane or malathion should kill the larvae in the mines.

Root aphids. The roots of asters and other plants are often infested with mealy, white, wingless aphids. These aphids are usually carried in by ants. Killing the ants usually gets rid of the aphids. Chlordane or DDT dusts or sprays applied to the ant nests have controlled ants. Further information has been published in Circular 188 and Bulletin 515.

Six-spotted leafhopper, *Macrosteles divisus.* This insect is also known as the aster leafhopper. It feeds by sucking the juices from the plants and is responsible for the transmission of aster yellows from diseased to healthy plants. In the spring the insects feed on diseased wild plants and then carry the virus to cultivated asters, marigolds, calendula, chrysanthemums, cosmos, dahlia, and gaillardia. The adults are about one-eighth of an inch long and greenish gray in color. DDT dusts or sprays have given excellent control of leafhoppers on asters. Control of aster yellows has been difficult, however. It has seldom been possible to prevent some spread of yellows before all leafhoppers are killed.

Stalk borer. This insect is a borer in aster. See Dahlia.

Azalea

For diseases see Rhododendron

Azalea bark scale, *Eriococcus azaleae.* Azalea plants growing out-of-doors are frequently infested with the white cottony or woolly masses of this insect fastened to the twigs, usually in the axils of the branches or close to the buds. Both sexes are enclosed in a felt-like sac. Tests proved that malathion spray applied about June 15 controlled this pest. See Bulletin 578.

Azalea leaf miner (also known as leaf roller) *Gracilaria azaleella.* The insect is a small yellow caterpillar one-half inch long. At first it lives in the leaf; however, before completing its feeding stage it leaves the interior of the leaf and folds over the margin, continuing its feeding on the surface. Injured leaves turn yellow and shed. Lindane or malathion sprays have controlled this pest.

Black vine weevil. See Taxus.

Lace bugs. Both the azalea lace bug, *Stephanitis pyrioides,* and the rhododendron lace bug, *S. rhododendri,* may injure azalea by sucking the juice from the underside of the leaves. Malathion, lindane, or DDT sprays have controlled these pests. See Circular 194.

B

Barberry

Wilt, *Verticillium albo-atrum.* Yellowing of the leaves and wilting of shoots or entire plants is followed by eventual death. Brownish discoloration of water-conducting tissues in wood is characteristic. The causal fungus is soil borne and often gets into a plant through cultivator injuries. If barberry plants have died of wilt, replacements should be planted elsewhere. No control is known. It is advisable to avoid root injury in transplanting and cultivation.

Rust, *Puccinia graminis.* This fungus shows as bright orange pustules on the underside of the barberry leaves in early summer. The alternate host is wheat and Merion bluegrass. Eradication of barberries for protection of wheat and bluegrass is indicated. In the north, sprays of ferbam or zineb may be tried on barberry when leaves are half grown, full grown and again 10 days later.

Barberry aphid, *Rhopalosiphum berberidis.* This small yellowish-green ahpid is often very abundant on the leaves and tender shoots, and sucks the sap. A thorough spraying with nicotine solution and soap, or malathion, is a good remedy.

Japanese weevil, *Pseudocneorrhinus setusus.* The weevils feed on the margins of the leaves of barberry and other shrubs, leaving characteristic crescent-shaped notches. The weevil is about one-fifth of an inch in length, robust, and varied brown in color. The wing covers have faint whitish lines and whitish spots on the apex. DDT or chlordane sprays or dusts should control these weevils.

Barberry webworm, *Omphalocera dentosa.* Blackish white-spotted caterpillar occasionally make webs on the twigs and devour the leaves. The adult is a grayish brown moth with wing spread of about 2 inches, and belongs to the family Pyralidae. Spraying with DDT or lead arsenate will prevent defoliation.

Barley

See **Small Grains**

Beans

Anthracnose, *Colletotrichum lindemuthianum.* The fungus which causes this disease is carried in the seed. The use of clean, western-grown seed has greatly reduced the amount of anthracnose in Connecticut. The disease appears on the leaves as a reddish-brown discoloration of the veins, particularly on the undersides of the leaves. The main damage is to the pods, where blackish-brown spots appear. These spots may have a pinkish ooze at their centers, and borders of red. The disease is usually found where growers have saved and planted their own seed. Inert copper or zineb fungicides will control the disease. Spraying should begin at the late-bloom stage, and be applied 3 or 4 times, once every week.

Figure 22. Anthracnose on beans.

Bacterial blight, *Xanthomonas phaseoli.* Small wet spots appear on the leaves. These spots may or may not have yellow borders. Severe infection will kill the young plant. The pod symptoms are dark green, wet-looking blotches, sometimes having red borders. The bacteria are seed carried. The use of clean, western-grown seed has practically eliminated the disease in Connecticut. Bacterial blight is spread rapidly by driving rain or hail. If there is an outbreak, keep out of the field when the plants are wet with rain or dew. The use of disease-free seed will prevent the appearance of this disease.

Mosaic. Injury by this virus appears on the leaves as a regular light and dark mottling. The pattern may be yellow and green. The disease is usually restricted to a few plants in any one field. Aphids carry the

virus from plant to plant. The virus is also present in alfalfa and clover; therefore, avoid planting beans next to fields of alfalfa or clover. There is no control.

White mold, *Sclerotina sclerotiorum.* Dark, watery spots appear on the pods, stems, and leaves. The stems may be rotted through, causing the wilting and death of parts of the plant, or of the whole plant. Infected pods turn into a soft, watery mass. The pods touching the ground are most likely to rot. Very soon after the rot has begun, a white moldy fungus growth appears on the rotted areas. After a few days, hard, black kernels, called sclerotia, may be found in the drying fungus mass. The fungus carries over as these sclerotia, which are resistant to drying and temperature changes. The fungus may persist as sclerotia in soil for at least 10 years.

The white mold fungus also causes drop rot of lettuce. The only recent serious outbreak of white mold in Connecticut has been in a bean field where lettuce had been grown the previous year. The best method to avoid white mold is to practice crop rotation, and not to plant beans on an old lettuce field. Usually, white mold is not serious enough in Connecticut to require any other control measures.

Damping-off, *Pythium debaryanum, Rhizoctonia solani.* The base of the stem appears rough and discolored, usually reddish-brown. This fungus disease is sometimes severe enough to kill young plants. All commercial seed is treated with fungicide to prevent losses from this disease.

Sun scorch. The leaves look withered and burned. This sometimes happens when a few hot, dry days follow a period of cool, cloudy weather.

Bean aphid, *Aphis fabae.* This black aphid occasionally occurs on green and snap beans but is more apt to infest broad beans. There are many generations each year. Eggs are laid in the autumn. They overwinter on various shrubs. Malathion gives control when needed.

Bean leaf beetle, *Cerotoma trifurcata.* This insect may occasionally cause injury. The adults feed on the underside of the leaves and on the stems of seedlings. The slender white larvae feed on the roots and stem below the soil surface. The adults vary greatly in color and markings but are typically reddish to buff in color with a black band around the outer wing margin and three or four black spots along the inner edge. They are about one-quarter of an inch long and overwinter as adults. Control has not been generally needed but can be achieved with materials listed for the Mexican bean beetle.

Potato leafhopper, *Empoasca fabae.* Adults and nymphs may infest beans and cause injury by sucking sap from the bottom side of leaves. This causes the young leaves to curl or gives them a white peppered appearance. The leafhopper can be controlled by dusting or spraying with DDT, methoxychlor, or malathion.

Figure 23. Exit holes of bean weevil.

Bean weevil, *Bruchus obtectus.* The beetle is about one-eighth of an inch long, brown, with wingcovers striped lengthwise with light brown and gray and mottled with darker spots. The adult lays eggs in the pods in the field. The grubs feed inside the seeds or beans and emerge after the beans have been placed in storage. They will continue to breed in the dried seeds and render them unfit for food or for planting. There are several generations a year. Beans saved for seed or for use dried can be protected by heating for one hour at 120° F., or by mixing the beans with hydrated lime at the rate of 1 pound to 1 bushel of beans. The lime is easily washed off in preparation for cooking.

Cutworms. See Tomato.

European corn borer. The larvae sometimes bore in the stems and pods of beans. See Corn.

Green cloverworm, *Plathypena scabra.* In certain seasons bean plants may be injured by inch-long green wiggling caterpillars that riddle the leaves. Materials used to control the Mexican bean beetle will control this pest, although control is not often necessary.

Green stink bug, *Acrosternum hilare.* This bug is from one-half to three-quarters of an inch in length, oval in shape, and bright green with yellow or reddish margin. This bug occasionally injures beans and various other plants by sucking sap from the shoots and leaves. Control measures have not been necessary against this insect.

Pachystethus lucicola. This beetle is about one-quarter of an inch long and usually light brown in color without markings, but a certain proportion of the individuals are black. In occasional years it may infest beans and feed on leaves. There is one generation a year. Required Mexican bean beetle control measures will also control this pest.

Mexican bean beetle, *Epilachna varivestis.* This is the most destructive of all insects feeding on beans in Connecticut and usually requires regular control each year. Both larvae and adults feed on leaves during the entire season.

The adult is a ladybeetle about one-quarter of an inch long, broadly oval, and pale yellow to coppery brown in color with eight small black spots arranged in three transverse rows on each wing-cover. The adults deposit yellow eggs in clusters of 40-50 on the leaves. The larvae are yellow with six rows of long branching black-tipped spines covering their backs (see figure 24). There are two generations each season, and adults overwinter in protected situations. Control can be achieved by spraying or dusting with malathion, methoxychlor, derris, or rotenone.

Figure 24. Mexican bean beetle.

Potato flea beetle. This flea beetle may sometimes feed on beans. See Potato.

Seed-corn maggot, *Hylemya cilicrura.* Small grayish-brown flies lay eggs in newly plowed fields and the dirty yellowish-white maggots that develop attack the seeds of bean and other vegetables, injuring or destroying them in the ground so that they do not produce good plants. Damage is much greater in cold, wet weather and when seed is deep planted. They can be controlled by treating the seed before planting with a commercial material containing a fungicide and an insecticide.

Two-spotted spider mite, *Tetranychus telarius.* This mature mite, which is about one-sixtieth of an inch long when mature, lives on the underside of leaves where it sucks plant sap. The leaves of infested plants have a sickly appearance, with yellow or reddish-brown blotches. Injury is most severe in hot, dry weather. Control has not been necessary in the past.

Wireworms. Seeds and underground stems of young plants may be attacked by several species of hard, smooth, shiny dark-brown wireworms about 1 inch long. Ground known to be infested can be treated before planting by the application of aldrin, heptachlor, or chlordane, harrowed into the soil.

Figure 25. Downy mildew on lima bean.

Beans, Lima

Downy mildew, *Phytophthora phaseoli.* Pods of lima beans may show this fungus disease as white, downy, felt-like mold. Very often the fungus will distort the young leaves and flowers, which are also covered with the downy mold. The disease breaks out only during very wet growing seasons so that fungicide sprays are usually not required for lima beans. Fungicides containing inert coppers, or zineb, may be used to control this disease.

Beebalm

Rust. *Puccinia menthae.* This rust is common on mints and has been found on cultivated species of *Monarda* as well as on species of *Mentha.* Infection occurs on the undersides of the leaves as small, light- or dark-brown dusty pustules which are usually abundant. A fairly definite spotting of the upper side of the leaf occurs. Cutting and burning plant remains in the fall after the top has been killed by frost will destroy the

spores. If the infection has been severe the previous year, spraying before new growth starts in the spring with the alkanolamine salt of DNOSBP (marketed as Premerge) is very effective. (3 lbs. actual in 40 to 60 gallons per acre).

Aphids. Beebalm is rarely infested by aphids *Aphis monardae,* which may be controlled by spraying with malathion.

Stalk borer. The stalk borer occasionally tunnels in beebalm. See Dahlia.

Beech

Anthracnose, *Gloeosporium fagi.* Occasionally in favorable wet seasons the leaves of cultivated beeches, especially the copper beech, will develop irregular, light-brown areas reaching inward from the margins or as isolated spots within normal green tissues. Control consists of spraying new leaves when half grown and again when full grown, with ferbam or thiram.

Leaf scorch. Leaves of beech are very tender when exposed to hot sun after prolonged cloudy weather, particularly when young. This burning may or may not be accompanied by too much fertilizer or by root injury.

Bark disease, *Nectria coccinea* var. *faginata.* This disease occurs in conjunction with infestation by the woolly beech scale. Feeding punctures made by the insects kill the living bark and produce cracks by means of which the causal fungus enters the tree. The foliage wilts, and individual twigs and branches die, followed by the death of the whole tree. Infection usually does not occur when the insects are removed soon enough.

Canker, *Polyporus glomeratus.* Cankers may form around dead branch stubs or on the trunk, preceded by wrinkling of the bark and often accompanied by the formation of dark-brown to black rough sterile conks. Painting wounds and removal and burning of infected wood are advisable.

Beech blight aphid, *Prociphilus imbricator.* This blue aphid punctures the bark. The insect may be covered with a cottony substance and may also be found on the leaves. Malathion or nicotine sulfate sprays should control this aphid.

Beech woolly aphid, *Phyllaphis fagi.* This aphid infests the under surface of the leaves of the European beech and its purple-leaf variety, but is not found on the white or American beech. It secretes white wax and infested leaves appear as though small tufts of cotton were fastened to them. Malathion or nicotine sulfate and soap sprayed against the under surface of the leaves is a good method of control.

Brown wood borer or pole borer, *Parandra brunnea.* This black-headed borer makes galleries in the wood and holes in the bark. The adult beetle is brown and about three-quarters inch long. The life cycle is 3 or 4 years. Adults are present just before flowering.

Mechanical injury to the bark enables the beetle to deposit eggs very easily and increases the damage done by this pest.

Spraying the bark with DDT several times during the growing season helps control this borer. The young may be killed before entering the tree, and DDT deposits also kill many egg-laying beetles.

Beech scale, *Cryptococcus fagi.* This scale is covered with a white waxy secretion which is attached to the bark of twigs and larger limbs. The scale itself causes serious damage and in addition allows infection by a bark disease. Dormant miscible oil sprays have given good control.

Saddled prominent, *Heterocampa guttivitta.* Occasional outbreaks of this insect have been responsible for periodic widespread defoliation of shade and forest trees in the mountain regions of New England and New York, especially of beech, birch, and maple trees. The eggs are laid on the leaves early in July, hatch in 9 days, and the caterpillars become fully grown in about 5 weeks, when they pupate and hibernate in the ground. There appears to be only one brood each year. The mature larva is about one and one-half inches in length with great variation in color and markings. Some are light yellowish-green and some are nearly purple. Many have a purple mark or saddle near the center of the body, but some have no saddle marks and there are all intergradations. The moth has a wing spread of one and one-half to two inches and is olive gray in color without prominent markings.

DDT spray will control this pest.

Beets

Leafspots, *Cerospora beticola.* Small circular, tan spots appear scattered over the

leaves. The spots have a purple border. This fungus disease is also found on chard and mangels. As the disease is seed carried, it may be reduced by treating the seed for seven minutes in a solution made of 1 liquid ounce of formaldehyde in 2 quarts of water. The seed is then rinsed, and may be planted at once or dried. If leaf spot appears, the spread of the disease may be slowed by spraying with 4-2-50 Bordeaux. Crop rotation should be practiced if the disease becomes a problem.

Scab, *Actinomycies scabies.* A fungus disease which makes corky spots on the roots. Scab usually appears in heavily limed soils.

Aphids. The black colored bean aphid and the green peach or spinach aphid feed on beets. See Bean and Spinach.

Blister beetles. Several species of large active, slender soft bodied beetles may occasionally feed on the greens. They are usually dark colored and may have thin white lines on their wing-covers. The larvae live in the soil where they feed entirely upon grasshopper eggs. Control is not usually necessary.

Flea beetles. Several species of flea beetles as the potato, *Epitrix cucumeris,* pale-striped, *Systena blanda,* red-headed, *Systena frontalis,* and smart-weed flea beetle, *Systena hudsonias,* may feed on beets. Young plants may be damaged though older plants show no injury to the feeding. Control measures are rarely necessary.

Garden springtail, *Bourletiella hortensis.* Small seedlings may be fed upon by minute dark purple, yellow-spotted insects that eat small holes in the leaves. These insects have no wings but are equipped with forked, tail-like appendages by means of which they throw themselves into the air. They are usually found only on small plants near the surface of the soil. Control by dusting the seedlings lightly with a chlordane dust.

Spinach leaf miner. This leaf miner may infest beets. Control by treating with malathion. See Spinach.

Begonia

Powdery mildew, *Oidium begoniae.* This not uncommon trouble looks like a white dust on the leaves and may appear on begonias anywhere, either tuberous or fibrous-rooted.

Sulfur dusts or sprays will control it. Afternoon application is most effective because the fungus sporulates at that time.

Corky scab. A physiological trouble which appears as light brown dry corky growths on the under side of the leaves and stem. It may be due to overwatering during cloudy weather.

Leaf spots, *Phyllosticta begoniae, Gloeosporium begoniae, Cladosporium* sp. These leaf-spotting diseases may be characterized by discreet lesions or a coalescing of infected areas and may easily be confused with the bacterial leaf spot or foliar nematodes. Laboratory analysis is indicated.

If sprays of ferbam, thiram, or captan do not halt progress of the trouble, other causes should be looked for. Avoid splashing water on leaves, particularly on cloudy days or late in the day.

Bacterial leaf spot, *Xanthomonas begoniae.* These small blister-like spots appear on both tuberous and fibrous-rooted begonias in greenhouses but are not so apt to occur on household plants. The spots are translucent. As they grow the center dries to a tan color, often with dried yellowish ooze on it, but the margin of the spot remains translucent. The bacteria may become systemic and cause collapse and death of the plants.

Avoid syringing leaves with water to control this disease. Also pick and burn infected leaves or branches when possible. Spacing plants to permit freer air circulation is helpful.

Blotch, *Botrytis cinerea.* This fungus causes a rot and grey mold when humid conditions due to overcrowding or cloudy weather favor its development.

Improving ventilation will help stop the trouble. It is important to avoid wetting the foliage when watering because the fungus will not grow without moisture.

Root rots, *Thielaviopsis basicola, Pythium* sp., *Rhizoctonia solani.* Determination of the causal fungus in the laboratory is essential for treatment. The symptoms may be generally poor condition, wilting, lack of growth. The *Pythium* and *Rhizoctonia* infections may be controlled by the oxyquinoline sulfate treatments. (See p. 5).

Foliar nematodes, *Aphelenchoides fragariae.* Water-soaked blotches appear on the underside of the upper surface and soon involve the entire leaf. The whole plant may become stunted. Nematodes are spread by splashing water from soil to leaf or from leaf to leaf, so that care in watering plants to keep leaves dry on both sides is important.

Aphids. The melon aphid and probably other species occasionally infest begonia. They may be killed by spraying with nicotine sulfate and soap or with malathion.

Mealybug. See Lantana.

Bellflower

For diseases see Campanula

Garden slugs. See Lettuce.

Birch

Rust, *Melampsoridium betulinum.* Infected birch leaves show reddish-yellow pustules on the underside of the leaves which sometimes cause defoliation. This rust has the larch as alternate host but the spores from the infection on birch leaves can spread to other birches. The disease is not serious enough to warrant control measures.

European canker, *Nectria galligena.* Paper and yellow birch are attacked by this fungus which forms cankers on branches near forks. These cankers may show as concentric rings of callus growth. The main trunk, if infected, is often flattened and bent.

Pruning and burning of affected wood is desirable. Cut out small cankers; sterilize and paint wounds.

Aphids. Of the many species of aphids two are very common. The yellowish birch aphid, *Calaphis betulaecolens,* and the waxy birch leaf aphid, *Euceraphis deducta,* sometimes occur in large numbers. Migration of winged aphids in swarms occur when the infestation is severe.

Birches grown as ornamentals can be sprayed with malathion or nicotine sulfate to control aphids.

Birch leaf miner, *Fenusa pusilla.* Leaves of gray birch, paper birch, and European white birch and its cut-leaf variety, especially the tender terminal leaves on young trees and sprouts, are commonly injured by the larvae of this insect and turn brown. The tender leaves at the tops of tall trees are less severely injured. The adult is a small black sawfly having three annual generations and in some seasons a partial fourth. The insect will not lay eggs in the older and hardened leaves. (See figure 26).

The leaf miner may be controlled by spraying with lindane or malathion emulsion as soon as the eggs hatch. This can be determined by examining the terminal leaves starting about May 5. When the small mines can be seen by holding the leaves up to the light the spray can be applied. Some seasons the second generation may require control. Spraying will be needed late in June or early in July.

Figure 26. Work of birch leaf miner.

Birch sawfly, *Croesus latitarsus.* The larvae of this insect are occasionally found feeding around the margin of a birch leaf. As a rule they are all headed the same way and the distal portion of each body is elevated. The adult is a four-winged fly with blue-black body and white markings on the legs. Control measures have not been necessary except in rare instances when young ornamental birch trees were being injured. Spraying with DDT should prove effective.

Birch leaf skeletonizer, *Bucculatrix canadensisella.* This insect has periods of great abundance about every 11 years when it defoliates white birch trees in the northern states. There is one generation each year. The adults emerge from the cocoons in June and July and the females lay eggs on birch leaves. The eggs hatch in 15 days and the larvae mine in the leaves for the first three instars, or nearly a month; then for the last two instars, or about 2 weeks, they feed externally on the under surface of the leaves, skeletonizing them. The larvae complete feeding the latter part of September and spin cocoons under fall leaves and other debris on the ground where they pass the winter.

Birches injured are the gray birch, paper birch, yellow birch, and European white birch.

Spraying with DDT or malathion about the middle of August will protect the trees against injury.

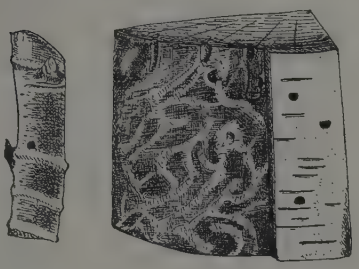

Figure 27. Work of bronze birch borer.

Bronze birch borer, *Agrilus anxius.* This insect is the most destructive to the European white birch and its cut-leaf variety of any insect occurring in Connecticut. The upper portion of the tree is usually first infested, and shows spiral ridges on the bark of the branches. In some cases, however, trees have become infested down to the base of the trunk. The beetles emerge late in May or early in June through semicircular exit holes. The eggs are laid in crevices in the bark during June, and apparently there is only one generation a year. The nearly mature grubs form cells in the burrows in which they hibernate, and in the spring transform to pupae. (See figure 27).

Control of this and other borers is rather difficult, The adult beetles feed on foliage, and spray of DDT applied in late May and June may kill some adults. Thorough spraying of the trunk and branches once or twice in June may also help to kill beetles before eggs are laid.

Case bearer, *Coleophora salmani.* This is a light yellowish-green caterpillar about one-fifth of an inch long which mines in the leaves and causes them to shrivel. Small cases are formed on the underside of the leaves. The adult moth is brown in color. Winter is passed in cases on the bark.

Spraying with lime sulfur before growth commences in the spring should kill the overwintering larvae. Also spraying with DDT or malathion in late July or early August may be expected to kill the summer caterpillars.

Gypsy moth. The caterpillars of this insect feed upon birch. See Oak.

Leopard moth. The larvae are occasional borers in birch. See Apple.

Oystershell scale. This is a common scale on young birch sprouts. See Apple.

Tussock moths. Several species. See Hickory and Horsechestnut.

Bittersweet

Powdery mildew, *Phyllactinia corylea.* White powdery appearance of leaves indicates the presence of this fungus which spreads in hot dry weather.

Sulfur dusts or sprays applied in the afternoon to new and old growth will control the disease.

Aphids. The bean aphid, the spiraea aphid, and the pea aphid all infest the bittersweet. Spraying with malathion or nicotine sulfate and soap will control them.

Euonymus scale. Bittersweet often becomes infested by the euonymus scale. See Euonymus.

Two-marked treehopper, *Enchenopa binotata.* This grotesque little insect has a curious projection on the thorax that makes it resemble in profile a bird. When several individuals walk along the stem one behind another, one thinks of a flock of geese marching single file. The eggs are laid in white frothy masses on the twigs, and young and adults are present in July and August. The adults are dark brown with two narrow white spots on the ridge of the back.

Ordinarily control measures are not needed, but the young may be killed by sprays of DDT or malathion.

Blackberry

Orange rust, *Caeoma nitens.* This rust is characterized by large masses of bright orange spores on the underside of the leaves. This rust is perennial in the plant and eventually will cause a stunted plant with small yellowish green leaves. Because it is perennial in the plant the only remedy is pulling and burning the infected plant. The disease is not serious.

Crown gall, *Erwinia tumefaciens.* See Raspberry.

Leaf spot, *Septoria rubi.* This is a common leaf spot occurring on various species

of blackberry and dewberry. The leaf infections appear as small, circular whitish or light brown spots with purple borders. Similar spots may occur on the young stems. Although common, this disease rarely is severe enough to warrant control measures.

Blackberry leaf miner, *Metallus rubi.* The larva of this sawfly is a miner in the leaves of blackberry and dewberry, and the insect has two generations each year. Eggs are laid in blisters on the under side of the leaves in May and early June for the first brood, and in August for the second brood. The larvae mine the margins and distal extremity of the leaf blades, making blotch mines which are usually confluent when several miners are at work in the same leaf. The adult is a nearly black four-winged fly about one-sixth of an inch in length.

Although satisfactory control for this insect has not been worked out, there is a probability that the larvae may be killed by spraying the leaves with DDT or malathion.

Blackberry psyllid, *Trioza tripunctata.* This jumping plant louse is a native of the wild blackberry, but occasionally it injures cultivated plants. The adult is about one-sixth of an inch long, yellowish brown, and each wing is marked by three yellowish brown bands. The adults live through the winter in protected places, appear on the plants soon after growth begins, and lay eggs in the pubescence of leaf-stems and tender shoots. Both nymphs and adults puncture the stems and leaves causing a stunted and distorted growth sometimes called galls. The nymphs become fully grown late in the season and the adults hibernate. There is one annual generation.

Control measures have not been worked out and probably will seldom be necessary.

Blackberry sawfly, *Pamphilius dentatus.* Occasionally in Connecticut blackberry leaves are devoured by the larvae of this insect. The adults appear the latter half of May, and the females lay white oval eggs placed end to end and fastened by the side to the larger veins on the under side of the leaves. The larvae roll the leaves, fasten them by a web, and feed inside the web. They become fully grown the first half of July and are then about three-fourths of an inch in length and of a bluish green color. They then enter the soil to remain until the emergence of the adults the following May. Spraying with DDT will prevent defoliation by this insect.

European fruit lecanium. This scale often infests blackberry. See Peach.

Raspberry root borer. This insect is also a borer in blackberry roots. See Raspberry.

Raspberry sawfly. This species has been recorded from blackberry. See Raspberry.

Red-necked cane borer, *Agrilus ruficollis.* Swellings from 1 to 3 inches long are often made by this insect on the new canes. The adult is one-third of an inch long, with blue-black wing-covers and reddish or copper-colored thorax. There is only one annual generation and the beetles, though present on the bushes from May to August, are most abundant in June. The female lays eggs in the bark near a leaf stalk. Each larva burrows upward in the sapwood and goes around the twig several times in a spiral course forming swellings or galls. The larva hibernates in the pith, where it completes its growth and pupates the following spring.

When the annual pruning takes place, all infested canes should be removed and burned.

Rose scale. This scale infests rose and blackberry. See Rose.

Blueberry

Mummy berry, *Monilinia vaccinii-corymbosi.* The characteristic symptom of this disease is the hollow, dry mummied fruits on the bush at picking time. Under the dry skin of the fruit is a thin black layer which is the overwintering stage of the fungus. The mummies fall to the ground and the following spring produce a spore stage which infects the blossoms. The fungus persists in the growing fruit which by mid-season is converted to the mummies described above. Clean cultivation and the consequent covering of the mummies with soil deep enough to prevent the dissemination of the spring spore stage has been used largely as a control measure. Neither this method nor spraying has been entirely satisfactory. We have observational data indicating that where blueberry plantings are heavily mulched, mummy berry is not a problem. This may result from either the killing of the fungus in the mummied fruit by drying or exposure to low winter temperatures. Or it may mean that contact with he soil is necessary to induce spore production from the mummies.

Stunt. A virus disease exhibiting one type of symptom in mid-June and a different

type in the fall. In mid-June there is a faint chlorosis of the foliage on infected branches and the more striking symptom of fruit clusters with berries only about half normal size. In the fall there is a more definite foliage chlorosis accompanied by a reddening of the tips and borders. This latter symptom can be confused with magnesium deficiency unless one is familiar with both. The whole plant is not involved at one time. Stunt may at first show only on an occasional twig, later spreading to other parts until the whole plant is involved. Stunt is transmitted in the field by a sharp-nosed leafhopper and can be transmitted by budding. The causal virus has not been definitely characterized but much of the syndrome of the disease resembles that of X disease of peach and it could be postulated that the blueberry stunt virus is a strain of, or closely related to, the virus of X disease. There is no practical field control except complete destruction of the insect vector. Experimentally soil applications of calcium chloride have improved the condition of infected plants but the practical value of such treatment has never been shown.

Blueberry maggot, *Rhagoletis pomenella.* The apple maggot commonly infests blueberry and huckleberry. Two or three sprays of rotenone applied at weekly intervals starting when the berries begin to turn blue has helped control this pest.

Blueberry bud mite, *Aceria vaccinii.* This is a 4-legged mite so small that it can be seen only with a microscope. Infestations cause distorted flower buds or even stop bud development. Feeding causes the skin of berries to be rough. Mites are present throughout the season.

The Burlington variety apparently escapes damage by this pest. Malathion sprays may give some control.

Blueberry bud worm, *Rhynchagrotis anchocelioides.* This is one of the cutworms that develops in weeds under the bushes. The larvae may eat fruit buds. Clean cultivation reduces the abundance of bud worms, and cutworm baits have given good control.

Blueberry flea beetle, *Haltica torquata.* This bronze beetle is about one-fourth of an inch long, and feeds on the margins of blueberry leaves in midsummer. It is not common and no control has been required.

Blueberry thrips, *Frankliniella vacinii.* The small slender thrips attack the plants early in the spring, feeding on terminal leaves. These leaves remain rolled together and the thrips continue feeding all summer.

Spraying with malathion should control these thrips if the spray penetrates the rolled leaves. Spraying the soil with dieldrin early in the spring is said to be effective.

Cherry fruitworm, *Grapholitha packardi.* This worm is an occasional pest of blueberries, and may be controlled by sprays used for the cranberry fruitworm.

Cranberry fruitworm, *Mineola vaccinii.* These worms feed on berries, entering at the stem end. They migrate from one fruit to another, even after the berries have been harvested. The moths pass the winter in the cocoon stage in wasteland.

Sprays of methoxychlor or malathion in the late bloom stage and again a week later have worked in our tests.

Cranberry rootworm, *Rhabdopterus picipes.* These small white grubs with a brown head may feed on the roots of blueberries, cranberries, and other bog plants. Bog land may be infested before cultivated plants are set. The beetle is mahogany brown and about one-fourth of an inch long. It feeds on foliage early in the summer. There is one generation a year.

Plowing new land a full year before planting should eliminate infestation. The soil may be treated for rootworm control by discing-in DDT or chlordane. See Potato, wireworms.

Cranberry weevil, *Anthonomus musculus.* The adult is a snout beetle a little more than one-sixteenth of an inch long, and dark brown or black in color. These beetles cut into swelling leaf and fruit buds. Eggs are laid in the flowers, and the grubs eat the flower parts. The adults hibernate over the winter.

Clean cultivation and destruction of trash on surrounding land helps reduce the number hibernating. Spraying or dusting with DDT, methoxychlor, or malathion just as the buds swell has killed overwintering beetles.

Datana worm, *Datana angusii.* This is a relative of the red-humped caterpillar on apple. Since it feeds in colonies, destruction by hand is possible. If abundant, methoxychlor or rotenone sprays or dusts may be used.

European corn borer. These larvae may bore in blueberry after migrating from infested weeds. Control is usually unnecessary. See Corn.

Fall webworm. This pest occasionally attacks blueberries. See Apple.

Japanese beetle. The Japanese beetle may feed occasionally on blueberry. See Rose.

Leafrollers. Several species have been recorded from blueberries. They are seldom abundant enough to require control.

Plum curculio. This pest may also attack blueberry. The control is the same as for fruit worms above.

Putnam scale, *Aspidiotus ancylus.* This round scale is the most common attacking blueberries. Damage is worst on older bushes and heavy infestations may deform the stem by congregating on rough wood. The scale may feed on fruit.

This scale occurs on forest trees. Pruning to remove old heavily infested wood helps keep damage at a minimum. Dormant sprays using superior oil have controlled this and other scales.

Red-humped apple caterpiller. This pest may also attack blueberries. If control is required, rotenone may be used.

Red-striped fire worm, *Gelechia trialbamaculella.* The young larvae are pale green, and later develop reddish brown stripes. Fully grown larvae are uniform brown in color. They fasten two or three leaves together and feed within.

Spraying with rotenone before the leaves are webbed together should control this insect.

Rose chafer. This general pest may feed on blueberries. See Rose.

Sharp-nosed leafhopper, *Scaphytopius magdalensis.* This small leafhopper is a carrier of blueberry stunt. It is rare in Connecticut at present.

Stem borer, *Oberea myops.* Blueberry shoots are sometimes girdled by this slender beetle. The adult is about one-half an inch long, and light brown with black wing covers and eyes. The girdling occurs when the adults lay eggs in the stems. The grubs bore into the stem and require 3 years for development.

Cutting off and burning recently wilted shoots destroys the young grubs.

Stem gall, *Hemadus nubilipennis.* These galls are produced by larvae of the chalcis fly feeding in the stem. They pass the winter in the galls, and can be eliminated by cutting and burning the galls.

Terrapin scale. This lecanium scale is much larger and more convex than other scales on blueberry. It secretes large quantities of honey dew on which sooty fungus develops. It is seldom a serious pest, but may be controlled by the treatment for Putnam scale.

Bleeding Heart (Dicentra)

Crown rot, *Sclerotium rolfsii.* Plants wilt and die. A cobwebby weft of white mycelium usually is found on the lower stem. Sclerotia may be embedded in diseased tissues or scattered over the surface of the ground near plants.

Removal and destruction of plants is best unless infection is very light, in which case a solution of bichloride of mercury 1:1000 (see p. 78) may be poured around the plant. Plants so treated often recover.

Boston Ivy

Leaf spot, *Guignardia bidwelli.* Irregular pale tan spots with dark brown borders are characteristic of infection by this fungus, which is the same one that causes black rot on grapes. On both hosts it overwinters on old leaves, stem cankers, and mummied fruits.

Spraying with thiram plus a spreader when the leaves are half-grown and again when full-grown will control it. Destruction of old infected leaves and mummied fruits is advisable if possible.

A circular leaf spot is caused by *Phyllosticta viticola.* These spots are also brown but the leaves may turn yellow and drop.

Control is the same for both leaf spots.

Downy mildew, *Plasmopara viticola.* This fungus produces irregular and definite yellow blotches on the upper side of the leaves; the underside of the blotch is covered with a white mold resembling downy mildew on lettuce and late blight on tomato. Eventually these spots turn brown.

Sprays of zineb as soon as the fungus appears should halt its spread. A spreader is needed to assure adequate coverage, and to be most effective, the sprays should be applied to the underside of the leaf. Sprays may be repeated at weekly intervals until fall.

Powdery mildew, *Uncinula necator.* This fungus looks like a white dust on the upper side of the leaves and is often found on Virginia-creeper. The disease flourishes in hot weather.

Sulfur sprays or dusts are applied to the foliage for control, making the application in the afternoon, the time when the fungus sporulates.

Eight-spotted forester. The caterpillars feed upon the leaves of ivy. See Virginia-creeper.

Leafhoppers. Leafhoppers that usually infest the grape are also found upon Boston ivy. Spraying the under surface of the leaves with DDT, malathion, or lindane will control leafhoppers.

Soft scale. See Fern.

Sphinx caterpillars. Some of the sphinx caterpillars or hornworms that are found upon the grape occasionally occur on Boston ivy. See Grape.

Boxwood

Leaf and twig blight, *Volutella buxi.* Leaves and twigs die back in late summer. Pink masses of spores may be found on the under side of the pale tan leaves or bursting through bark of infected twigs. Leaf casting may also be caused by two other fungi which can infect twigs. (See figure 28).

Three sprays 10 days apart of ferbam, thiram, or Bordeaux, with a spreader, when new growth starts will control these troubles. If wood is affected, pruning well back of diseased area and periodic removal of all dead leaves and twigs is important and may make it unnecessary to spray.

Winter injury. Severe cold and drying winds of late winter may produce a burning on exposed boxwoods. Leaves may become greyish-green or brown with dead twigs.

Protection from exposure, as well as care to let the season's growth harden off before winter (which may well mean not applying too much fertilizer), has been found very helpful.

Bronzing. Foliage may appear bronze from causes other than red spider. This has been attributed to root-lesion nematodes, hot sun, winter burning, and nutritional unbalance. Laboratory examination of roots is suggested. Boxwoods usually grow out of this trouble.

Figure 28. Leaf and twig blight of box.

Boxwood leaf miner, *Monarthropalpus buxi.* This is the most serious insect pest of box in Connecticut. The adult, which is a two-winged fly, lays eggs in the leaves in June. The larvae live in the leaves between the upper and lower epidermal layers, usually several in each leaf, but they do not devour the green tissue as do most leaf miners. Certain whitish spots with leaves somewhat blistered and distorted are the only external indication that the leaves are infested. (See figure 29).

Lindane or malathion sprays applied about May 15 and again June 15 gave good control of this pest in our experiments.

Figure 29. Work of the boxwood miner.

Boxwood psyllids, *Psylla buxi.* These jumping plant lice, in both adult and nymphal stages, infest box and suck the sap. They overwinter as young nymphs under the bud scales. The young feed in the spring and adults appear in May. Eggs are laid at

Figure 30. Work of psyllids on boxwood.

the base of the buds. Feeding punctures cause a cupping of the terminal leaves. There is only one generation a year. (See figure 30).

Lindane or malathion sprays applied about May 15 and June 15 have controlled psyllids.

Mites, *Tetranychus telarius and Simplinychus buxi.* Ornamental boxwoods may be injured by these mites, especially in dry seasons. The first species varies in color from pale yellow to purplish red with conspicuous dark spots. The other mite is green to yellowish brown. Injured foliage appears blanched or silver-like in color. Some webbing is noticeable.

Malathion or Aramite sprays have controlled these mites. They may be applied as often as mites increase in abundance.

Oystershell scale. This scale sometimes occurs on box. See Apple.

Broccoli and Brussels Sprouts

In general, the pests that injure cabbage also attack these plants. See Cabbage.

Buckwheat

Aphids. Several species of aphids may feed on buckwheat but these have not required control in the past.

Wireworms. These common soil inhabiting insects may occasionally feed upon the roots of buckwheat, particularly if the soil has only recently been taken out of sod. See Meadow.

Figure 31. Healthy boxwood.

Butternut

For insects see Walnut

Anthracnose, *Gnomonia leptostyla.* An irregular brown or blackish leaf spot which infects leaves early in the summer, and if severe, causes them to drop.

Control may be obtained by applying two sprays to new leaves when they are half and just full grown using ferbam, thiram, or Bordeaux mixture.

Dieback, *Melanconis juglandis.* Twig and branch dieback is characteristic of this disease which is sometimes accompanied by leafspotting. Badly diseased trees have a stag-headed appearance.

Control is difficult, but pruning and destruction of all affected parts well back of apparently infected wood will reduce chance of further infection.

Root- and heart-rot. Several of the wood-rotting fungi may attack butternut as wound parasites and contribute to the decline and death of the trees.

No control has been worked out other than proper care for wounds by cleaning, shaping, and painting them with a good tree paint.

C

Cabbage

Black rot, *Xanthomonas campestris.* This bacterial disease appears on the leaves as yellow, wedge-shaped areas with darkened veins. These leaves are usually wilted. There are black streaks visible in the stem when it is split open. The head finally rots. Black rot is a wet-weather disease spread in the field by splashing rain or insect feeding. The bacteria live over in the soil, in plant refuse, or in seed from diseased plants. The only control at present is to keep the disease out of the field by the use of clean, hot-water treated seed, crop rotation, and removal of plant refuse.

Figure 32. Cabbage black rot.

Black leg, *Phoma lingam.* This disease, caused by a fungus which lives in soil, rots away the stem of young plants. The leaves turn yellow and the plants fail to grow. Crop rotation and removal of plant refuse help control this disease.

Clubroot, *Plasmodiophora brassicae.* Plants with clubroot have yellowed leaves which wilt on hot days. The roots are enlarged and misshapen, cracked, and often rotted. The slime mold which causes this disease lives in the soil and enters the plant through the roots.

The clubroot organism may be accidentally carried from place to place by infested soil. Farm machinery, implements, or water may spread the disease. Clubroot attacks all members of the cabbage family, including weeds such as mustard.

To avoid carrying the disease into the field, only healthy seedlings should be taken from the plant bed for transplanting. Young cabbage plants in an infected seed bed may be protected by being watered with a solution

Figure 33. Cabbage clubroot.

of corrosive sublimate at the rate of 1 ounce in 10 gallons of waer. Apply 1 gallon of corrosive sublimate solution per 40 feet of row. The solution is watered on as soon as the plants are through the ground, and the application is repeated once a week for 4 or 5 weeks.

Soils more acid than pH 7.2 favor the development of clubroot. Hence, a standard practice to control clubroot is to neutralize the soil acidity by broadcasting and turning in hydrated lime. At least 1500 pounds of lime must be applied per acre for good control. Even more will be required on most soils depending on the acidity.

Another effective control method which may be used in place of hydrated lime is the use of calomel in the transplant water. Calomel is not water soluble so it should be purchased mixed with gum arabic, which will keep the calomel in suspension when it is mixed with water. Use 8 ounces of calomel per 50 gallons of transplanting water. About 400 gallons will be needed for an acre of cabbage, and 700 gallons for planting an acre of cauliflower.

Avoid planting infested fields with any crop belonging to the cabbage or mustard family.

Downy mildew, *Peronospora parasitica.* This fungus disease is not common on cabbage and related crops in Connecticut, but is usually found on seedlings in cold frames when it does appear. The disease appears as faint yellow spots on the leaves, and may show a white, fuzzy growth on the underside of the spots. These spots rapidly grow together and may kill the whole seedling. These symptoms usually appear only on the outer leaves of plants in the field. The fungus overwinters in the soil.

To avoid an outbreak, it is best to keep the cold frame as dry and as warm as is possible without stopping plant growth.

If mildew shows up in the plant bed, the spread of the disease may be slowed or stopped by spraying with wettable Spergon. Use 2 pounds of Spergon per 100 gallons of water and spray three times a week.

Boron deficiency. Boron is required by the plant in very small amounts for normal development. Even this small amount may be removed by intensive cultivation, or may be tied up in the soil by a highly alkaline condition. Cabbage plants deficient in boron will have wilted leaves, poor heads, and brown spots in the main stalk. Cauliflower plants deficient in boron have loose discolored heads, narrow twisted leaf tips, and dark, watery spots in the roots.

The proper amount of boron to apply to the soil with fertilizer should be determined by a soil analysis, because excess boron may injure the plants. Boron has also been sprayed on foliage as an emergency measure when crops show boron deficiency during the growing season.

Yellows, *Fusarium conglutinans.* Infected plants appear stunted, sickly and yellow. The leaves turn purple to brown, and the older leaves drop off. Scraping the lower stem will show streaks of discoloration.

The fungus which causes cabbage yellows survives in the soil for many years and attacks the cabbage plants through the roots. The disease is favored by high soil temperature and high soil moisture. Fortunately, there are many cabbage varieties very resistant to the cabbage yellows fungus. Now the disease is rarely seen on cabbage in Connecticut. It shows up occasionally during a hot summer, on cabbage planted in a low, wet spot in the field. Planting resistant varieties avoids the disease.

Black leaf-spot, *Alternaria brassicae.* This fungus disease appears as large, black target-spots. This is a leaf-spot usually attacking the older, outside leaves of plants of the cabbage family. The disease does not usually require special control measures.

Bacterial leaf-spot, *Pseudomonas maculicola.* This disease shows as small, dark spots on the leaf. The spots appear translucent or water-soaked when the leaf is held up to the light. The spots may grow together, and cause the death of part or all of the infected leaf.

This bacterial disease is not common in Connecticut. When it does appear, it is more likely to attack cauliflower than any other cabbage-family crop. The bacteria are most likely to infect during prolonged periods of warm, driving rains. No special control measures are required.

Cabbage aphid, *Brevicoryne brassicae.* This whitish, powdery aphid occurs in dense clusters on the leaves where it feeds on plant sap. The leaves of infested plants crinkle and curl, growth is retarded and dwarfed heads are produced. There may be as many as 16 generations in a season. The aphid overwinters as glossy, black eggs on the leaves and stems of old plants remaining in the field. Malathion may be used to control this pest.

Figure 34. Cabbage looper.

Cabbage looper, *Trichoplusia ni.* This caterpillar, which humps its back or loops when it crawls, eats holes deep into the cabbage head. It is light green and striped lengthwise with white and darker green. Its body is nearly smooth and is narrowest at the head. The adult is a grayish-brown moth with a small silvery spot resembling a figure 8, near the middle of each forewing. It flies at night when it deposits small round greenish-white eggs, singly on the upper leaf surface.

It often feeds with, and can be controlled by the same materials used against the cabbage worm. (See figure 34).

Cabbage maggot, *Hylemya brassicae.* This insect infests the stems of early set cabbage and other crucifers. As a rule, late planted cabbage is not injured, but late radish and turnip may be damaged. The white maggots

Figure 35. Cabbage maggot.

infest the stems just below the surface of the soil and infested cabbage and cauliflower plants usually wilt and die without forming heads. The gray flies, which look like small houseflies, appear about the middle of May and the females lay eggs on the surface of the soil near the stem of the plant. There are three broods each year, and the insect hibernates in the pupal stage in the soil.

This insect may be controlled by dusting with heptachlor or dieldren around the stem of each plant as soon as it is set, or by using these materials in the transplanting water.

Figure 36. Cabbage worm.

Imported cabbage worm, *Pieris rapae.* The cabbage worm is bright green in color, covered with close-set hairs and is about an inch long when mature. It feeds upon the outer leaves throughout the season and is the larvae of the white butterfly that is so common about cabbage fields. The butterfly has a wingspread of about one and three-quarters inch and is white with a tinge of sulfur yellow. The tips of the forewing are gray, and the male bears one and the female two black spots on each forewing. The eggs are yellow and are laid singly on the under surface of the leaves.

They can be controlled by dusting or spraying with methoxychlor, malathion, DDT, rotenone, or pyrethrum. (See figure 36).

Cutworms. See Tomato.

Diamond back moth, *Plutella maculipennis.* Although usually a minor pest, at times this insect causes considerable injury to cabbage and allied plants by eating small holes through the outer leaves. The larvae are pale green and only about a quarter inch long when full grown. They are very active, and when disturbed wriggle and drop to the ground. The pupa is enclosed in an open-work net attached to the leaves and in this stage the insect hibernates. The adult is a small gray moth with light yellow rear margins on the forewings. It has a wing spread of five-eighths of an inch.

The usual applications for control of the cabbage worm will also control this insect.

Hop flea beetle, *Psylliodes punctulata.* If crops have been neglected, this dark shining flea beetle may build up and cause damage by feeding on the leaves.

It is usually kept in check by control measures directed against other insects.

Wireworms. See Tobacco.

Zebra caterpillar, *Ceramica picta.* This black caterpillar with bright yellow markings is a general feeder, being found on nearly all kinds of vegetables as well as many flowering plants. It is about two inches long when full grown. The moth is reddish brown and without prominent markings. The rear wings are nearly white with brown margins. There are two generations each year. Control is not usually necessary.

Cactus

Cactus scale, *Diaspis echinocacti.* This light gray circular scale infests certain species and varieties of cactus under cultivation.

Spraying with malathion or nicotine sulfate and soap two or three times at 10-day intervals should give good control.

Calendula (Pot Marigold)

Leaf spot, *Cercospora calendulae.* Small spots appear which coalesce and progressively destroy leaves, stem, and eventually the entire plant. Most varieties are susceptible. Ferbam or thiram sprays give good control. Maneb or captan may be tried on an experimental basis.

Stem rot, *Sclerotium rolfsii.* A rot of the crown of the plant, with white cobwebby mycelium growing over the crown in which are numerous sclerotia the size of mustard seeds, ranging from pinkish buff to reddish-brown in color.

A soil drench of corrosive sublimate (see p. 78) 1:2000 applied twice 7 days apart may help if the plants are not too far gone. Otherwise infected plants and soil should be removed, and fresh clean soil used as a replacement. If all plants can be removed from the bed, then the soil can be sterilized with formaldehyde.

Grey mold, *Botrytis* sp. Flowers in particular may be rotted by this fungus during prolonged humid or wet weather. A grey fuzzy mold follows petal spotting which rapidly rots the flower.

No known spray gives good control of *Botrytis*. Reducing relative humidity through improved ventilation has proven a useful means of control.

Powdery mildew, *Erysiphe polygoni, Sphaerotheca fuliginea.* Both these fungi appear as powdery white spots on the leaves. Sprays of sulfur applied in the afternoon when the fungus produces its spores will kill spores and protect uninfected leaves.

Foliar nematode, *Aphelenchoides ritzemabosi.* This nematode also infests chrysanthemum leaves, and the symptoms are much the same. Water-soaked discolored spots appear first on the underside of the lowest leaves, quickly penetrate to the upper side and involve the whole leaf which turns brown and hangs down.

Use of clean uninfested soil is important. Calendula should not follow mums or asters if any infestation has been noted in the previous crop.

Mosaic. Cucumber mosaic virus. Mottling and distortion of leaves is frequently accompanied by necrotic areas. Insect carriers are several species of aphids and probably the spotted and striped cucumber beetles. Other hosts are delphinium, columbine, buckwheat, pokeweed, the cucurbit family, periwinkle, primula, China asters, and zinnias.

Removal of infected hosts and insect control are essential to control of this disease.

Ringspot. Tobacco ringspot virus. Pale zig-zag lines appear on leaves, and rarely ring-like spots. The disease is sap-transmissible by some unknown insect and is found in cucumbers, petunias, snap beans, zinnias, pokeweed, and scarlet sage. Removal of infected plants and insect control are indicated.

Blister beetles. See Aster.

Greenhouse whitefly. See Tomato.

Red spider. See Phlox.

Tarnished plant bug. See Celery.

Thistle butterfly or painted-lady. The caterpillars feed on calendula. See Hollyhock.

Calla Lily

Root rot, *Phytophthora richardiae.* The symptom first noticed is the yellowing and dying of outer leaves that progresses toward the center of the plant. Roots rot toward the rhizome, leaving a hollow cylinder. Eventually the rhizome becomes infected and is grey and punky. The fungus may be followed by the soft rot organism which has a foul odor.

To control: the old rhizomes require thorough cleaning, cutting out all rotted spots and allowing the tissue to dry out. Dormant rhizomes are soaked for 1 hour before planting in New Improved Ceresan plus spreader (1 lb. Ceresan to 50 gals. water or 1 oz. in 3¼ gallons), drained and planted immediately. Soil sterilization is indicated before planting if possible. A 2 per cent formaldehyde solution may be substituted for the Ceresan—length of treatment is the same.

Leaf spot, *Phyllosticta richardiae.* Light brown spots merge to form a blighted area and may appear on leaf stalks and flowers. Infected plant parts should be destroyed and a spray of ferbam or thiram plus spreader applied.

Spotted wilt. A virus disease common on dahlias, tomatoes, peppers, and other hosts. Whitish or yellowish flecks and spots appear on leaves, petioles and buds, often with concentric rings. Leaves are twisted and wrinkled, and flowers are deformed.

The disease is carried by thrips. Therefore eradication of infected host plants and thrip control keeps down the disease. Selection of healthy planting stock is a requisite.

Aphids. Certain species of aphids are occasionally troublesome on the leaves of Calla lily. A good remedy is to spray with malathion or nicotine and soap.

Yellow woollybear. The caterpillars feed upon calla leaves. See Verbena.

Camellia

Camellia scale, *Fiornia fioriniae.* This yellowish brown scale with white margins, a distinct dorsal carina, and nearly parallel sides, infests a great many different plants in the greenhouse, including camellia.

Malathion or nicotine sulfate sprays have given good control of the immature stages.

Fuller rose beetle. See Rose.

Mealybug. See Lantana.

Soft scale. See Fern.

Campanula (Bellflower, Canterbury Bells)

Rust, *Coleosporium campanulae.* Infection occurs as orange or red pustules on the undersides of leaves which may be killed. Plants may be stunted. Alternate hosts are pitch, red, and probably Scotch pines.

Spraying bellflower leaves with ferbam, thiram, or zineb should control this disease, starting in mid-May and keeping leaves covered for a month.

Powdery mildew, *Erysiphe cichoracearum.* Whitish "dust" on leaves and stem indicates presence of this fungus which thrives in hot dry weather. Sulfur sprays or dusts applied in the afternoon will prevent further spread.

Stem or crown rot, *Sclerotinia sclerotiorum, Sclerotium rolfsii.* These rots although caused by different fungi are similar in the wilting and collapse of the stem. Sclerotia or hard resting-bodies of the fungus may be found in rotted plant tissue or in the soil.

Control for both consists of roguing affected plants and removal of infested soil. If plants are not badly decayed, a soil drench of mercury bichloride 1:2000 (see p. 78) may be tried. If all plants can be removed, soil sterilization with formaldehyde is indicated.

Root rots, *Rhizoctonia solani. Fusarium* sp. Symptoms are more or less the same for these fungi and show as wilting and lack of growth of plants, rotting of roots and crown and eventual death. The *Fusarium* infection may cause a brown discoloration in the cut stem. Otherwise diagnosis must be made by microscopic examination.

The *Rhizoctonia* may be controlled with the soil drench of oxyquinoline sulfate (see p. 5) if the disease has not progressed too far. The same chemical may help against the *Fusarium* infection.

Canna

Bacterial bud rot, *Xanthomonas cannae.* Small white spots appear on the leaf as it unrolls. In heavy infections leaves may be partly or wholly black. Lesions on older leaves do not enlarge but appear as brown spots or streaks causing distortion. Flowers may be killed by the infection of young buds or the stem.

Selection of healthy corms is essential. A preplanting soak for 2 hours in corrosive sublimate 1:1000 (see p. 78). Keeping foliage dry and humidity down by adequate ventilation is desirable. Plants that are set outdoors should be spaced well apart.

Asiatic garden beetle. See Lawns.

Canna leaf rollers, *Calpodes ethlius* and *Geshna cannalis.* These may occur in the northern states but are killed by severe winter weather. The larvae of the large canna leaf roller cuts a section out of the margin of the leaf and rolls it over and lives within while it feeds. Later holes are eaten in the leaf. The larva is green with an orange head and transforms to a brownish butterfly. The lesser canna leaf roller has similar habits in addition to tying the young leaves together before they open.

Lindane, malathion, or lead arsenate sprays, applied several times during the season have given good control of the pests.

Greenhouse leaf-tier. This insect occasionally injures canna. See Celery.

Japanese beetle. The adult beetles feed upon the blossoms. See Rose.

Cantaloupe

See Cucumber

Carnation

Wilt, *Fusarium dianthi.* The first symptom is a dull green color to the plants which wilt and eventually turn straw-color. Cutting across the main stem reveals brown discoloration sometimes accompanied by a dry punky rot. A pink mass of spores may or may not be present on the roots.

Wilt is caused by a soil-borne fungus which enters the plant through root wounds and plugs the water-conducting system, killing the plant. Plants that have been outside are very apt to become infected. The disease may be carried in infected cuttings.

Wilt may show up at any time but is particularly noticeable after rooted cuttings have been planted in flats or benches or in late winter when flower production draws on the strength of the plant.

Soil sterilization is of utmost importance in control of the disease. Clean cuttings and sterilized sand in the cutting bench are very important. Our research has indicated new chemotherapeutic soil drenches to be effective.

Biweekly applications of oxyquinoline sulfate 1:4000 (see p. 5) to newly benched Millers Yellow carnations infected with *Fusarium* wilt greatly reduced the number of wilted plants. This treatment should be used in conjunction with soil sterilization for best control. Treatments are started as soon as rooted cuttings are flatted or benched and applied twice a week for 3 weeks

Bacterial wilt, *Pseudomonas caryophylli.* This organism also causes wilting of plants or shoots but is accompanied by splitting of the stems particularly at the joints and frayed yellow streaks in the vascular system. Tissue just under the epidermis is sticky and cutting across the stem shows discoloration and a bacterial ooze. The disease appears to spread rapidly at high temperatures. Although the parasite works internally, it is spread by splashing.

No known control other than to use clean cuttings, to rogue affected plants, and avoid splashing water. Experiments suggest treatment with antibiotics as a promising control measure.

Root-and-crown rot, *Rhizoctonia solani.* Similar in symptoms to Fusarium wilt except the stem is usually rotted at the ground level. No vascular discoloration shows when stem is cut. Several soil drenches with oxyquinoline sulfate at 1:4000 (see p. 5) will control this disease if applied in time.

Leaf spots, *Septoria dianthi.* Pale tan spots with purple borders appear on leaves. Sometimes small black fruiting bodies are scattered over the surface of the spots. Avoidance of splashing water and spraying with ferbam or thiram plus sppreader will control it.

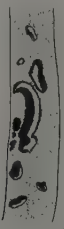

Figure 37. Rust pustules on carnation.

Rust, *Uromyces caryophyllinus.* Chocolate-brown eruptions on leaves and stems of susceptible varieties characterize this disease. Control consists of use of rust resistant varieties or spraying with zineb, thiram, or ferbam plus spreader before infection takes place.

Botrytis flower rot, *Botrytis cinerea.* Brown spotting or rot of flowers particularly on Northland, Virginias, Olivette, Millers Yellow, and other susceptible varieties. A grey mold over these brown spots is the fruiting stage of the fungus.

Since quantities of the fungus fruit on dead plant material at the base of the plants, elimination of infected parts is almost impossible. Preventing a sharp drop in temperature by turning on heat one-half hour before sundown particularly during late winter will keep moisture from condensing on flowers and thereby prevent infection by this fungus.

Mosaic, streak, yellows. Virus diseases which may show as light mottling in the leaves (mosaic), or red or yellow spots or streaks (streak), or yellows, a combination of both diseases. Streaks in the flowers are due to mosaic or yellows infection.

Control is best obtained by using only healthy stock. Also care in disbudding is necessary as these viruses are carried by mechanical contact. Aphid control is important to prevent spread.

Alternaria leaf spot and branch rot, *Alternaria dianthi.* Whitish spots on leaves show fungus infection which may invade the branch and cause death of the plant above the infected part.

Sprays of Bordeaux, zineb, or ferbam, plus a suitable spreader, can be applied at weekly intervals for control. Keeping the foliage dry by avoiding syringing will be helpful.

Aphids. The green peach aphid and the leaf-curl plum aphid, *Aphis helichrysi,* infest the young leaves and buds, suck the sap, and are often troublesome in greenhouses. Malathion or lindane sprays, or greenhouse aerosols, will control these aphids.

Red spider. This is an important pest of carnations. Malathion or Aramite sprays, or greenhouse aerosols will control red spider. See Phlox.

Variegated cutworm, *Peridroma margaritosa.* Larvae of the variegated cutworm frequently infest greenhouses in the fall and are responsible for considerable injury. They

climb the stems and eat holes into carnation buds, and feed upon a great many other plants. The moth has a wing spread of between one and one-half and two inches, with brownish gray forewings. The caterpillar is light brown mottled with darker brown. Normally there are two annual generations out-of-doors, but there may be more in the greenhouse.

Good control has been obtained by dusting the surface of the ground with 5 per cent chlordane or 2½ per cent dieldrin. Use of commercially prepared cutworm baits should also be effective.

Carrot

Leaf blight, *Macrosporium carotae.* Blight on carrot foliage starts as dark brown spots which grow together and may kill whole leaves. If the disease is very severe, the whole carrot top may be killed. This fungus disease usually attacks the older foliage. Ordinarily, carrots in Connecticut do not require spraying for the control of this disease. In wet seasons, however, carrot foliage may be protected by spraying with maneb. Thorough spray coverage is essential for control.

Yellows. Carrots with yellows have an abnormal number of leaves. The leaves are yellow, twisted, and stunted. The roots remain slender and have an abnormal number of fine hairy roots. Carrot yellows is caused by a virus which also causes lettuce yellows and aster yellows. The virus is carried by leaf hoppers. To keep down the amount of disease, control leaf hoppers with DDT and avoid planting carrots near lettuce or asters.

Rootknot. Infected plants are stunted and sickly, with knots on their small, feeding roots. This disease is caused by nematodes. See Tomato, rootknot.

Aphids. The bean aphid, *Aphis fabae,* green peach aphid, *Myzus persicae,* and corn root aphid, *Anuraphis maidi-radicis,* all occasionally infest carrot. Control is usually not necessary.

Celeryworm. This caterpillar, which is the larvae form of the large black swallowtail butterfly, is occasionally found on carrot. See Celery.

Carrot rust fly, *Psila rosae.* This slender dark-green fly lays eggs in the soil close to the plant late in May and the young maggots work their way downward along the root and begin feeding at the tip of the top root. Later the entire root may be tunneled. The burrows are rusty brown in color, which explains the name. The maggots pupate in the soil and there are two generations of the fly each season. The first brood maggots feed during June and the second brood during August.

This insect has not been a serious pest in Connecticut and control has not been necessary. Neighboring states have found seed treatment to be effective for first-brood, and an application of aldrin, dieldrin, or heptachlor effective in controlling second-brood rust flies.

Catalpa

Leaf spot, *Phyllosticta catalpae.* Small dark brown or black spots appear on the leaves in early summer which may coalesce later to make irregular black blotches. The tiny black fruiting bodies of the fungus appear later.

Control is by spraying with ferbam or thiram when the leaves are half grown and when fully expanded.

Wood rot, *Polystictus versicolor.* This wood-rotting fungus is very destructive to catalpa and usually shows as reddish and white areas in the sapwood.

No control has been worked out, but good care of tree wounds, that is, shaping the wound and painting with a good tree paint (see p. 5) may prevent entrance of the fungus.

Catalpa leaf miner, *Agromyza clara.* This leaf miner starts a serpentine mine which later becomes a blotch mine, often involving the entire leaf. Lindane or malathion sprays, applied just as the mines start, should control this pest if it becomes abundant.

Catalpa mealybug, *Pseudococcus comstocki.* This whitish pulverulent deposit in the crevices of the bark in the axils of the twigs and leaf stems and on the under side of the leaves may contain the adult females, nymphs, and eggs, together with abundant wax secretion. There are two or three generations each year, and treatment is often necessary. Good control has followed sprays of malathion or nicotine sulfate and soap.

Catalpa sphinx, *Ceratomia catalpae.* The larval stage of this pest strips the leaves from infested trees. They are about 3 inches long and yellow and black in color. The moth is grayish-brown and 3 inches in wingspread. The pupae overwinter in the ground. DDT, malathion or lead arsenate sprays early in May and again in mid-August will control this pest.

Cauliflower

In general, the insects that injure cabbage also feed upon cauliflower. See Cabbage.

Cedar

See Juniper

Celery

Early blight, *Cercospora apii.* This blight appears as large, irregular, dark-brown spots on the leaves and stems. The leaf spots are generally bounded by the veins. In severe cases the spots grow together and kill the leaves. Early blight is caused by a fungus which may be carried in the soil or on the seed. The fungus does not live in the seed for more than 2 years. When using newer seed, it may be best to disinfect it by dipping for 30 minutes in hot water (118° F.). Celery foliage may be protected against early blight by spraying with any one of the following materials: zineb, nabam, dichlone, Bordeaux, or fixed copper.

Figure 38. Celery late blight.

Late blight, *Septoria apii.* Late blight is a fungus disease which appears as small, circular, tan leaf and stem spots. Usually there are small, black dots scattered across the tan spots. Gelatinous threads of spores are exuded from these dots during wet weather. The control measures for celery late blight are the same as for celery early blight.

Nematode injury, *Paratylenchus hamatus.* These tiny eelworms, which are too small to see with the naked eye, live in the soil and feed on the roots of celery and other plants. They stick their beaks into the plant roots and suck the food from the plant tissue. Although the nematodes are individually very small, they may be present in such numbers that they will cause stunting and yellowing of celery and other crops. Lownsbery and co-workers at this Station found that celery soil may have as high as 10,000 nematodes per pound of soil. They found that celery plants with 18,000 nematodes per plant averaged about one-third the weight of celery plants not infested with nematodes.

Nematodes may be controlled in the field with various soil fumigants such as chloropicrin, methyl bromide, ethylene dibromide, DD mixture, and various other newer materials which are now appearing on the market.

Boron deficiency or cracked stem. Celery deficient in boron has many parallel cracks across their stems. Later the tissue between the cracks curls up in strips. The leaves of deficient plants may show areas of brownish discoloration.

Aphids. The green peach aphid, *Myzus persicae,* is the most common form which feeds on celery. It can be controlled with malathion.

Carrot rust fly. This insect may occasionally feed on the roots of early celery. See Carrot.

Celery or greenhouse leaf-tier, *Phlyctaenia rubigalis.* Although this small greenish-white, striped caterpillar may occasionally feed on leaves, it is not a serious pest and control is rarely needed.

Celeryworm, *Papilio ajax.* The adult is the common large black swallow-tail butterfly which may spread almost 4 inches. It has two nearly parallel rows of yellow spots on the outer margins of the wings and other light blue areas on the rear wings. The caterpillars, which are about 2 inches long when fully grown, are green with a yellow spotted black crossband on each segment.

This insect overwinters as a tan colored chrysalid and there are two broods each year. They rarely require control other than hand picking. (See figure 39).

Figure 39. Celeryworm

Parsnip webworm. See Parsnip.

Two-spotted spider mite. See Bean.

Tarnished plant bug, *Lygus lineolaris.* This bug injures many different kinds of plants by sucking sap from the tender leaves and shoots. On celery the injury shows as darkened sunken areas about one-quarter inch in diameter on the leaves and shoots near the top of the plants. The tarnished plant bug is a mottled brownish bug about one-fifth of an inch long that hibernates in protected places. The eggs are inserted in the tender tissues of plant stems, leaves, and buds, and the young bugs or nymphs are yellowish green and pass through five nympal stages before becoming adult. Dusting or spraying with DDT or pyrethrum is the control.

Chard

Bean aphid. This aphid sometimes infests beet and chard. See Bean.

Blister beetles. Several species may feed on chard. See Beet.

European corn borer. This insect may bore in the leaf stems of beet and chard. See Corn.

Flea beetles. Several species of flea beetles may feed upon chard. See Beet.

Garden springtail. This tiny insect may damage seedlings of beet, chard, and other garden vegetables. See Beet.

Spinach leaf miner. Occasionally this insect will tunnel the leaves of beet and chard. See Spinach.

Cherry

Leaf spot, *Coccomyces hiemalis.* Leaf spot appears as reddish-purple spots on the leaves, these spots later turning brown. The centers of the spot may or may not fall out giving a "shot-hole" effect. The causal fungus overwinters on the old leaves. The fungus produces ethylene in the leaf which causes a yellowing and dropping of the foliage. In wet springs infection may occur early in the season but with dry spring weather the spotting may be delayed until after fruit harvest.

Spraying with a fungicide at petal fall, 2 to 3 weeks later, and right after fruit harvest should give control. In some seasons the last spray only will be enough. Occurs on both sweet and sour cherries.

Brown rot. See Peach.

Black knot. More prevalent on sour cherries. See Plum.

Powdery mildew. See Apple.

Black cherry aphid, *Myzus cerasi.* This is a brown aphid which occurs on the under side of the leaves, causing them to curl. It migrates to bluets and may be found on them late in summer, but passes the winter in the form of black glossy eggs on the twigs of cherry.

The remedy is to spray with malathion or nicotine sulfate and soap after the eggs hatch and before the leaves become curled.

Cankerworms. See Apple.

Cherry maggots or fruit flies, *Rhagoletis cingulata* and *R. fausta.* Two species of fruit flies occasionally cause wormy cherries in addition to the plum curculio. They are closely related to the apple maggot, which they resemble as the adults have banded wings. Both species each have one annual generation. Infested cherries do not fall but hang on the tree and sunken areas show on them. The flies of both species emerge in June and are controlled by spraying the trees early in June with methoxychlor.

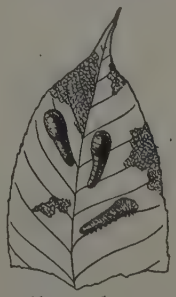

Figure 40. Cherry slug or pear slug.

Cherry slug or pear slug, *Caliroa cerasi.* The slug-like larvae feed upon the upper surface of the leaves, especially on young trees, eating away the green tissue and skeletonizing them. The adult is a small black, shiny, four-winged fly, called a sawfly, which appears in May and inserts eggs in blisters in the leaves. The larvae pass through five instars, but during the fifth go into the ground to pupate. Adults emerging in July

and August lay eggs for a second generation, for there are two broods each season in the northern states. (See figure 40).

The slugs may be killed by spraying the leaves with lead arsenate, methoxychlor, or DDT.

Eastern tent caterpillar. See Apple.

Fall webworm. See Pear.

Plum curculio. See Plum.

San Jose scale. See Pear.

Ugly-nest caterpillar, *Archips cerasivorana.* This insect often feeds upon both wild and cultivated cherry trees. The ends of the branches are enclosed in large pointed webs or nests with yellow larvae feeding upon the leaves. The adult moth has a wing spread of about an inch and the forewings are yellow with brown and blue markings. The females lay flattened egg-clusters on the bark of the branches and cover them with a glue-like material for protection. They remain until the following spring before they hatch. The webs may be cut off and burned, or the foliage sprayed with DDT.

Chamaecyparis
(White Cedar, Retinospora)

Nursery blight, *Phomopsis juniperovera.* This tip dieback occurs occasionally on white cedar but is much more common and serious on red cedar. A small canker girdles the twig, which dies.

Control is difficult but has been obtained in the nursery with applications of New Improved Ceresan plus a spreader to the new growth before infection starts. Several sprays may be necessary to protect all new growth. Affected twigs should be cut and burned.

Foliage browning. All the "leaves" on the inside of the tree turn reddish-brown and fall readily to the ground either in spring or fall. This natural shedding occurs often after a dry season or may happen every second or third year varying with the individual tree and conditions. The discoloration is distinguished from fertilizer burn by being on the inside of the entire tree whereas fertilizer burn or sunburn due to root injury starts at the tip of the branch, working its way back, and generally progresses up the tree from the lowest branches. Red spider injury differs in that a bronzing usually of all the leaves on a branch or the entire tree may "suddenly" appear during the summer. Winter bronzing is due to physiological changes and is tied in some way with the nutrition of the plant as yet not understood. Winter bronzing disappears with the advent of warm weather.

Witches'-broom, *Gymnosporangium ellisii.* Witches' brooms appear at the ends of branches; on young trees the entire top may be broomed. Branches beyond the infection point usually die as soon as the fungus girdles the branch. Cross-sections of infected wood show wedge-shaped brown spots in the wood. In the spring, brown telial horns grow out of the infected area and produce spores that infect the bayberry and sweet fern, which in turn produce spores to reinfect the white cedar. The only control known is the eradication of the bayberry and sweet fern.

Gall rust, *Gymnosporangium biseptatum.* A good-sized spindle-shaped gall is indication of infection by this fungus. The branch beyond the gall usually dies. The life cycle of the fungus is completed on the serviceberry leaves whence come the spores that infect the white cedar. Mycelium in the cedar is perennial. Thus the fungus produces spores to infect the serviceberry every year from each infested location.

Gymnosporangium hyalinum. A small fusiform gall develops on twigs and branches, infective spores coming from the leaves of pears and hawthorn.

Since the fungus is perennial in the cedar, pruning and burning of affected parts is helpful. Alternate hosts, pear and hawthorn, should be eradicated within a half mile to be of most value.

Chestnut

Blight, *Endothia parasitica.* Infection by this fungus shows fairly near the ground on the main trunk of the tree or on a branch near the point of attachment to the main trunk. Longitudinal cracks in the bark and swelling is accompanied by sudden wilting and death of parts above the infection. The fruiting stages may appear as yellowish tendrils or clusters of reddish tubercles. No control is known. Breeding of resistant varieties is in progress.

Twig blight and dieback, *Cryptodiaporthe castaneae.* This fungus attacks young trees and branches causing cankers. It gains entrance by means of a dead twig, growing lengthwise in the wood and eventually girdling the branch. The primary trouble may be winter injury in varieties not quite hardy in the area or a lack of compatibility between stock and scion in grafted trees or some other adverse environmental factor. Once the fungus is in the wood, it progresses rapidly. Similar cankers and diebacks may be caused by other fungi.

Control is obtained by providing optimum growing conditions and the use of varieties well-adapted to the climate. Allowing growth to harden off in the fall before cold weather sets in may help prevent spring infection.

Aphids. The large gray aphid, *Longistigma caryae,* occurs on chestnut twigs, and a smaller yellowish green aphid, *Calaphis castaneae,* is found on the leaves. Spraying with malathion or with nicotine sulfate and soap will control them.

Cankerworms. Cankerworms feed upon chestnut. See Apple.

European fruit lecanium. See Peach.

Fall webworm. The fall webworm feeds upon chestnut. See Pear.

Gypsy moth. Gypsy moth caterpillars feed upon chestnut. See Oak.

Leaf mites. These mites infest chestnut and give the leaves a rusty brown color. See Oak and Phlox.

Tussock moth. See Horsechestnut and Hickory.

Two-lined chestnut borer, *Agrilus bilineatus.* The white flat-headed grubs of this beetle make tortuous and interlacing galleries under the bark of chestnut and oak. This grub is about half an inch in length, and the parent beetle is three-eighths of an inch long, black with two narrow converging longitudinal grayish stripes on the wing-covers. The beetles appear in May and June and deposit eggs. The grubs work in the inner bark and outer sapwood, pupating in cells in the wood. There is one annual generation each season, and mutilated, weakened and dying trees are often infested and killed by this beetle.

The adults feed somewhat upon the foliage, and some of them may be killed by spraying with DDT late in May and late in June.

Twig pruner. See Oak.

Yellow-necked caterpillar. See Apple.

Chinese Cabbage

Aphids. The potato aphid has been reported to feed on chinese cabbage. See Potato.

Purple-back cabbage worm, *Evergestis straminalis.* This caterpillar is about three quarters of an inch long when mature, bristly and with the body tapering at both ends. The back is purplish brown, the underside green and there is a yellow stripe running along each side. They sometimes feed upon the leaves, webbing them together, or bore into the stem and roots. There are 2 to 3 generations a year and the late brood is the most damaging. This insect is rare, however, and control is not usually necessary.

Chinese Lantern (Physalis)

Leaf spot, *Phyllosticta physaleos.* Circular gray to brown spots with dark borders showing small black fruiting bodies of fungus in center appear on leaves. Spraying with thiram or ferbam as soon as the spots appear prevents spread. Sprays may be repeated as needed.

Bacterial wilt, *Pseudomonas solanacearum.* Plants wilt slightly in the middle of the day. Wilting progresses until plant is dead. Vascular bundles are stained brown, and bacteria may ooze from cut stem. The bacteria also infect potato, tomato, and many other crops. Sterilize soil where *Physalis* is planted particularly if preceding crops have had trouble.

Virus diseases. This plant acts as a symptomless carrier for tobacco mosaic virus I. This virus is very infectious and may be transmitted by mechanical contact to tomatoes, peppers, petunias, Daturas, snap beans, and phlox.

Tortoise beetles. Several species of tortoise beetles feed upon Chinese lantern. See Sweet Potato.

Chrysanthemum

Leaf spots, (due to fungi) *Septoria chrysanthemella, Cylindrosporium chrysanthemi.* Small dark brown spots appear on lower leaves which coalesce to involve the entire leaf which turns brown and dies. The leaves

Figure 41. Septoria leaf spot on chrysanthemum

appear to die from the bottom of the plant up the stem. See Foliar Nematode for difference between fungus and nematode infection.

Sprays of ferbam or thiram applied weekly during the season will control these leafspots. Captan is reported to give good control also.

Figure 42. Injury caused by foliar nematode on chrysanthemum

Foliar nematode, *Aphelenchoides ritzemabosi.* Black to brown V-shaped areas appear in the lower leaves, showing first at the bottom of the plant and working their way up the plant. These spots are bounded at first by veins of the leaf but eventually may involve the entire leaf. The trouble is caused by microscopic eelworms which live in and destroy the leaf tissue. They come out of the leaf when the leaf surface and stems are wet with rain, dew, or syringing, and swim up the stem to infect the leaves above. The nematodes overwinter in plant debris in the soil.

The cultural method of control is to take garden mum cuttings early in the spring before the nematodes get started, destroying the mother plants and all plant debris in the area. The rooted cuttings are then planted elsewhere.

Wilt, *Verticillium dahliae.* Gradual wilting and dying of the plant follows infection by this fungus. The stem when cut across usually shows browning or blackening of the vascular system. The fungus enters through the roots or may be in the cuttings taken from infected mother plants.

Roguing infected plants, taking clean cuttings and planting in sterilized soil will prevent this disease.

Rust, *Puccinia chrysanthemi.* Rust pustules start as swellings on the underside of the leaves which soon break open discharging chocolate-brown powdery spores. These spores infect chrysanthemums and will spread the disease through the rest of the planting. The alternate host is not known.

Spraying plants with ferbam or zineb or thiram before infection takes place or as soon as noted should keep the rust in check.

Powdery mildew, *Erysiphe cichoracearum.* This fungus appears as a whitish powder on the leaves and spreads rapidly during hot dry weather. Spraying with sulfur in the afternoon, the time when the fungus is sporulating, will control its spread.

Grey mold, *Botrytis cinerea.* Appears as spots on flowers which enlarge and rot the entire flower particularly the light colored varieties. The fruiting of the fungus appears as a grey mold. It is particularly prevalent during wet or cloudy weather, and in greenhouses during late winter.

Control may be partially effected by improving ventilation and thus avoiding humid conditions. Turning the heat on an hour before sundown in a greenhouse will prevent a sharp drop in temperature which condenses moisture on the flowers and thus allows the fungus to grow. No fungicides give good control.

Stunt, Virus. This disease appears to affect part or all of a plant of garden and greenhouse mums. Infection is characterized by stunting of the entire plant or one or more branches and early production of off-color flowers. Leaves on infected branches may be smaller than normal, and flowers are small and a washed-out color.

Greenhouse stunt appears to be mechanically transmissible and may be spread by pinching and other handling practices. Breaking off buds rather than pinching or cutting with fingernail or knife helps keep trouble in check. Care in selecting healthy propagating stock, roguing infected plants as soon as noticed, and keeping plants free from insects, particularly leafhoppers which may carry the disease, will help in control. New stock should be kept segregated the first year if possible.

Rot of cuttings, *Botrytis cinerea* and *Rhizoctonia solani.* Both these fungi have been found rotting the bases of cuttings. In *Botrytis* infection a fuzzy grey mold which is the fruiting stage of the fungus shows at or just above the ground level, whereas Rhizoctonia is observed as brown fungus threads on the stems, often holding grains of sand to the stems or roots. Sand clinging to roots or stems usually indicates presence of *Rhizoctonia.*

Improved aeration will help to control *Botrytis,* coupled with a higher temperature maintained as steadily as possible. Our research shows that *Rhizoctonia* infection may be controlled by an oxyquinoline sulfate (see p. 5) soil drench applied *after* cuttings have rooted. (Application before will inhibit rooting processes.) Sterilization of the cutting bench aids greatly in prevention of *Rhizoctonia* disease.

Foot rot and wilt, *Fusarium* sp. A species of this fungus which may be related to the aster wilt fungus and which produces symptoms similar to aster wilt on mums may cause the lower leaves to turn yellow and die with a general wilting of the plant. The stem near the ground is greatly discolored and may show masses of pink spores. The vascular bundles are usually discolored when the stem is cut across.

Control is best obtained by using cuttings from healthy plants and sterilizing the soil. Infected plants should be destroyed. In the garden plants should be put in a new location.

Bacterial wilt, *Erwinia chrysanthemi.* This bacterium can infect a plant without causing symptoms unless certain conditions obtain, i.e., high temperatures and high humidity. The symptoms may be a reddish-brown darkening of the stem on older plants about half way up. When pinched the stem collapses and may be slimy with bacterial ooze. Pith is usually gone. The water-conducting tissues are reddish-brown both above and below the area. Infection may develop at the base or at the top of the plant; the bacteria often causing slow growth and stunting without other obvious symptoms. The disease may be spread by using infected cuttings or infected soil or by the pinching or cutting of flowers. Liquid dips for cuttings also offer a fine means of spread.

Selection of healthy cutting stock is important as is soil sterilization. Breaking stems during disbudding and flower cutting instead of pinching with fingernails or cutting with knife will prevent this means of spread. Use of 50 p.p.m. of streptomycin (½ oz. in 10 gallons) as a soil treatment to the cutting medium will give fairly good control. Keeping temperature below 65° F. or humidity low will prevent the appearance of symptoms.

Dodder. Many strands of orange "string" with no apparent roots and which are not readily detached are wound around the plants. Small clusters of whitish flowers produce many seeds for another year's crop. When seeds germinate, the dodder climbs up the nearest plant and sends little penetrating knobs, called haustoria, into the tissue of the host, by means of which it obtains its nutrients. The dodder roots are dropped as soon as this attachment is made, and it becomes a truly parasitic plant. Removal and burning of infested plants is essential.

Aphids. The green peach aphid and the chrysanthemum aphid, *Macrosiphum sanborni,* often infest chrysanthemum plants in the greenhouse. They may be controlled by spraying with malathion, lindane, nicotine sulfate and soap, or by the use of aerosol bombs. Aphids on chrysanthemums growing in the garden may be controlled by using malathion sprays as needed.

Cyclamen mite. See Cyclamen.

European corn borer. See Dahlia.

Gall midge, *Diarthronomyia chrysanthemi.* A small slender two-winged fly lays eggs in the leaves and tender shoots in greenhouses and each larva forms a cone-shaped gall. Plants in the open are not usually injured. Probably there is more than one generation each year, but it is difficult to

estimate the number on account of overlapping. The midge is more abundant in spring and fall than at other seasons. Damage from this pest can be reduced by bringing only clean cuttings or plants into the greenhouse.

Existing infestations can be controlled by two sprays of lindane or malathion in seven days.

Four-lined plant bug. See Currant.

Marguerite fly. This insect is a leaf miner in the leaves of chrysanthemum. See Marguerite, chrysanthemum leaf miner.

Mexican mealybug, *Phenacoccus gossypii.* Although there are other species of mealybug that attack mums, the Mexican mealybug is the most injurious. It attacks all stages of mum growth, causing a stunting of the plants through a distortion of the leaves. Malathion or nicotine and soap spray should give good control when repeated several times at weekly intervals.

Spittlebugs. These insects cause a stunting, curling, twisting of the terminal growth, side branches and infested leaves of hardy mums. The insects cover themselves with a frothy material, resulting in the common names "snake-spit" and "frog-spit." Malathion spray applied to the terminals during the spring and early summer should give good control.

Thrips, *Thrips nigropilosus.* The insect feeds in the developing flowers, causing a deformity and mottling. The adult of the "flower thrip," one of the species causing the most injury, is brownish-yellow in color with feathery wings. The young are lemon-yellow in color. DDT or malathion spray should control thrips.

Cineraria (Senecio)

Powdery mildew, *Erysiphe cichoracearum Mass.* Leaves have whitish powdered appearance. Sprays or dusts of sulfur applied as soon as noticed will help prevent spread.

Foliar nematode, *Aphelenchoides ritzemabosi.* Watersoaked spots appear first on the under side of the lowest leaves which soon work through to the upper side making brown blotches which involve the entire leaf. It is advisable to avoid splashing water from leaf to leaf or from soil to leaf when watering. Fumigation of potting soil is helpful before planting. (see p. 4).

Aphids, *Myzus persicae.* Green peach aphids are often present on the under surface of the leaves and on the tender shoots of cineraria in greenhouses. This pest may be checked by spraying with nicotine sulfate and soap, malathion, or lindane.

Greenhouse leaf-tier, *Phlyctaenia rubigalis.* This caterpillar is about three-fourths of an inch long when full grown, translucent greenish white, with a dark green dorsal stripe. When disturbed, the caterpillars wriggle violently and often drop to the ground. They usually feed on the undersides of leaves, but may web several leaves together. The adult is an inconspicuous, rusty-brown moth with a wingspread of almost an inch. There may be seven or eight generations a year in greenhouses.

DDT or malathion sprays applied before the leaves are webbed together will control this pest. Greenhouse aerosols are also effective.

Greenhouse whitefly, *Trialeurodes vaporariorum.* The tiny moth-like adult has a mealy appearance due to the small particles of wax that it secretes. It lays eggs on the under surfaces of leaves. They are placed singly on end, but arranged in a circle of from six to nine eggs. The eggs hatch in about 10 days, and the young move about some before they insert their beaks and suck the sap. At this time they begin to resemble scale insects, being oval in shape with a marginal fringe of short wax rods. Mature nymphs are yellow, and the adults emerge about 5 weeks after the eggs hatch.

Malathion or nicotine sulfate and soap sprayed on the undersides of the leaves should control this pest. Greenhouse aerosols also work.

Clematis

Leaf spot and stem rot, *Ascochyta clematidinae.* The spots first appear as watersoaked areas on the leaves, turning tan with a reddish margin and eventually becoming grey with small black fruiting bodies in the diseased tissue. The fungus may grow down the petiole into the stem and girdle it.

Removal of infected leaves and improving ventilation will help. Sulfur sprays have been suggested for control. Captan or zineb may be tried. Other fungi reported to cause leaf spots on clematis may be controlled by sprays of ferbam or thiram.

Rust, *Aecidium clematidis.* Uncommonly found on cultivated species. Infection appears as small closely clustered white cups on the

clematis, the II and III stages occur on certain grasses, especially quack grass. Some varieties of clematis are resistant to this fungus. Control may be obtained if necessary by spraying the clematis before infection with ferbam or thiram.

Clematis borer, *Alcathoe caudata.* The larva of this moth is a borer in the fleshy roots of clematis, especially *Clematis virginiana* and *C. jackmanii.* The moth is a clearwing with a wingspread of from one to one and one-fourth inches, the female being larger than the male. The former has head, thorax, and abdomen blackish, with antennae forelegs and rear tarsi, orange. Forewings are blackish or violaceous without transparent area; the rear wings are transparent with dark margin. The latter have narrow transparent areas at base of forewings. The moths emerge between June 15 and August 15, and the winter is passed by the larvae in various stages of growth in the roots. There is one generation each year. DDT sprays supplied to the base of the plants about June 15, July 15, and August 15 might help control the borers.

Tarnished plant bug. This bug sucks the sap from the leaves, slightly deforming them. See Celery.

Clover

Powdery mildew. This disease, which occurs wherever clover is grown, develops primarily in late summer and early fall. Dry weather favors its development. The fungus is evident as a white powdery mold on leaves and stems of infected plants. There are resistant strains of some clover species, and when practical, sulfur dusts and sprays may be used.

Sooty blotch. Dark brown or black angular blotches affect the leaves particularly of alsike and white clovers, less commonly red and crimson clovers. Leaves will turn yellow and wither when infection is heavy, as it may be on low wet land. Spraying or dusting with sulfur may be practical when the disease is severe.

Rusts. All stages of the causal fungi occur on clover and usually cause little damage except to susceptible varieties in the fall. Aecial infection may appear as light yellow to orange pustules on the stems, petioles, and leaves. The uredial stage, which is the most conspicuous sign of the disease, appears as small brown pustules on any portion of the plant. Sulfur dusts have been used as control measures but they are not highly effective.

Sclerotinia root-and-crown rot. This disease can cause extensive damage particularly during cool, wet weather. Symptoms usually appear first in the fall as brown spots on the leaves. Later in the winter and spring the leaves drop and the plant is overrun by white mycelia. The crown and roots may be rotted, causing wilting of shoots and death of the entire plant. Black sclerotia may be found in dead plant materials and the soil near the plants.

Although control is difficult, clean cultivation and deep plowing to bury the sclerotia are helpful. Adapted varieties are more resistant than poorly adapted strains of clover.

Wilts and root rots. These diseases can be caused by any of a group of soil fungi. Plants of all ages are attacked. The basic symptom is the generalized rot of any part of the root system. Wilting and yellowing of the leaves may follow in severe cases. Any cultural practice that increases the vigor of the plants is probably the best control measure.

Mosaics. Viruses are transmitted by aphids and leafhoppers. Several viruses are involved and they may appear alone or in combination with leaf mottling or chlorosis with or without dwarfing. Insect control will help prevent spread of infection.

Potash deficiency. The first indication is the appearance of numerous small white or yellow dots arranged in a crescent around the tips of the leaflets, followed by yellowing and downward cupping of the margins of the leaflets. This symptom is usually general throughout the plant. Soil and tissue analyses will confirm the cause of symptoms. By the time symptoms show it is too late for potash applications to that particular crop of clover, but subsequent crops will be benefited.

Blister beetles. See Alfalfa.

Clover bud weevil, *Hypera nigrirostris.* The adult beetles are about one-eighth inch long, brownish or bluish-green in color, with a small black head. They are chewing insects and cut slits in the stem just above the lateral buds. The larvae, which feed inside the buds or stems, are white with a black head and a dark line across the body just behind the head. This minor pest is usually controlled by methods directed against other insects.

Cloverhead caterpillar, *Grapholitha interstinctana.* Small greenish-white larvae feed in the flower heads preventing development. The adult is a small moth about a quarter of an inch long; dark brown with oblique silver dashes on the front margins of the wings. Control directed against other insects usually reduces this minor pest.

Clover head weevil, *Tychius stephensi.* The adults are about three-sixteenths of an inch long and may be brown with lighter stripes on the thorax or black with a gray or greenish tinge. The larvae vary in color from white to gray with brownish stripes running the length of their bodies. They feed in the heads and prevent their development. There is one generation a year. No special control is needed for this minor pest.

Clover leaf weevil, *Hypera punctata.* The adults eat large notches in the leaf margins. The grubs eat small areas from the underside of the leaves, which afterward become small round holes. Later, they eat irregular notches in the leaves. Greatest injury occurs in May. The adult weevil is about a quarter of an inch long, light brown with three darker stripes running lengthwise on each wing-cover. The brown cocoon is oval with an open mesh covering. There is only one generation a year.

This insect has not required special control in the past and seems to be reduced by measures directed against other insects.

Clover leafhopper, *Aceratagallia sanguinolenta.* This is a small, stout, light brown leafhopper marked with dark lines and spots. It sucks sap from the leaves and the injury shows as small whitish spots. No special control has been needed for this insect.

Clover root borer, *Hylastinus obscurus.* Both the adults and larvae feed underground where they bore deep tunnels in the roots and crown. The adult is a small, black beetle about one-tenth of an inch long and the white, brown-headed grubs are about the same size. They overwinter as adults and there is but one generation a year. The borer is most destructive in old stands of clover. Control has not been necessary in Connecticut.

Clover root curculios, *Sitona flavescens* and *S. hispidula.* There are two species of weevils in this group which are commonly found together in our fields. The adults are small, robust beetles varying from three-sixteenths to one-quarter inch in length with body colors ranging from light to dark brown with shadings of gray and brick red. The smaller beetle is darker and covered with short erect hairs. The adults feed on foliage during the spring and fall when they cut regular notches in the leaf margin. The larvae of both are small, grayish-white, legless grubs with light brown heads. They are much more damaging than the adults and feed underground where they cut numerous shallow cavities on the roots. There is one generation each year.

Clover seed weevils, *Tychius stephensi* and *Miccotrogus picirostris.* One or the other of two species of small gray weevils, each with long tapering heads, may feed on the flower heads. The young grubs feed and live within the developing seed. These insects are of minor importance in Connecticut ond no control has been required.

Grasshoppers. Several species of grasshoppers cause injury by feeding on the leaves of clover. See Meadow.

Green cloverworm, *Plathypena scabra.* This caterpillar is light green in color and is striped longitudinally with darker green and fine white or cream colored lines. The head is pale green, shining and hairy. It feeds on the leaves causing a ragged appearance. Special control is not usually necessary.

Meadow spittlebug. The feeding of the nymphs of this insect within their spittle masses, may cause severe damage to the first cutting. See Meadow.

Pea aphid. If abundant, this long legged, green aphid may be controlled with malathion. See Alfalfa.

Potato leafhopper, *Empoasca fabae.* This insect does not overwinter in Connecticut, but migrates north each year from more southern areas. First-cutting hay usually escapes injury, but subsequent growth may be fed upon by the nymphs and adults of this small, active, greenish-yellow leafhopper which sucks plant sap causing yellowing and stunting of the plants. When abundant, the application of malathion, following the first cutting, has given control.

Tarnished plant bug. This general feeder also attacks clover. See Meadow.

Wireworm. See Meadow.

Coleus

Black leg, *Pythium* sp., *Rhizoctonia solani.* Cuttings or plants rot at the ground level and

die. Use of sterilized rooting medium and potting soil is the best method of control for this trouble. However, if plants are lightly infected, a soil drench of oxyquinoline sulfate will help. A similar rotting by *Botrytis* sp. often occurs in crowded plants and will not be helped by the oxyquinoline solution. Laboratory determination of the fungus is necessary.

Leaf crinkle. Leaves may be crinkled or distorted by cyclamen mites. See Cyclamen.

Foliar nematode, *Aphelenchoides ritzemabosi.* Discolored spots appear on the leaves, starting first from the under side and gradually involving the entire leaf.

Nematodes are spread by splashing water, so that care in watering is helpful. Fumigation of potting soil (see p. 4) is advisable if infestation has been serious in the past.

Greenhouse orthezia. This insect is a common pest of coleus plants in greenhouses. See Lantana.

Greenhouse whitefly. This insect commonly infests coleus plants in greenhouses. See Cineraria.

Mealybugs. Coleus plants in greenhouses are very susceptible to infestation by mealybugs. See Lantana.

Red spider. See Phlox.

Columbine

Wilt disease, *Sclerotinia sclerotiorum.* Leaves and stems usually wilt and dry up, followed by death of the whole plant. Sclerotia which look like mustard seeds are often found inside the stem.

Soil drench of mercury bichloride (see p. 78) 1:1000 applied around the base of the plant may be effective if the disease has not progressed too far.

Asiatic garden beetle. See Lawns.

Columbine aphid. The columbine aphid, *Kakimia essigi,* in addition to several other species often causes stunting of the foliage in late summer. Spraying with malathion, nicotine sulfate, or lindane will control the aphids.

Columbine borer, *Papaipema purpurifascia.* The larva of this moth is a borer in the stem of columbine, often going downward into the fleshy roots. The borer reaches a length of about 1½ inches and is salmon-colored with a pale stripe along the back. The moth has a wingspread of 1¼ inches, and the forewings are light reddish brown in color with darker cross bands and purplish distal margins. Dusting the surface of the ground around columbine plants late in April with 5 per cent chlordane or 10 per cent DDT might provide some control.

Figure 43. Work of blotch leaf miner of columbine.

Columbine leaf miners. Two species of leaf-miners attack columbine. One, *Phytomyza minuscula,* makes serpentine mines and the other, *P. acquilegiana,* blotch mines. The miners feed to maturity and pupate on the undersides of leaves. The tiny two-winged flies emerge in about 2 weeks. In the fall, fully grown miners drop to the ground and crawl into the soil to spend the winter. Spraying with lindane or malathion should kill young larvae in mines. (See figures 43 and 44).

Figure 44. Injury caused by serpentine leaf miner of columbine.

Columbine skipper, *Erynnis lucilius*. The larvae of this insect chews holes in the leaves of columbine. It also rolls up the leaves when not feeding. When fully grown the caterpillar is about three-quarters of an inch long, and is green in color with a small black head. The adult is a butterfly. DDT or malathion or lindane spray should provide control.

Stalk borer. The stalk borer occasionally tunnels in the stalks of columbine. See Dahlia.

Coreopsis

Leaf beetle, *Chrysomela elegans*. This beetle occasionally feeds upon the leaves and flower stems of *Coreopsis lanceolata*, causing injury. It is one-fourth of an inch or less in length, dark bronze green, with two narrow cream-colored stripes lengthwise of each wing cover. Spraying with DDT is effective.

Corn

Smut, *Ustilago zeae*. Corn smut is a fungus disease which appears as enlarged, malformed overgrowths on all parts of the corn plant. These overgrowths, called "boils," are most prominent on the corn ear and tassels. These boils which enclose the fungus spores, are grayish-white when they are first formed. As the spores of the fungus ripen, the boils darken, until at last they burst releasing the spores. The ripened spore masses have a dark oily appearance. Sanitation measures and a 3-year crop rotation will reduce chances of an outbreak of corn smut. The boils may be cut out and burned. Infected refuse should not be left in the field, but removed and destroyed.

Bacterial wilt or Stewarts wilt, *Bacterium stewartii*. Corn infected with this disease is stunted and has wilted leaves on dry days. Brown streaks often appear along the leaf veins. Leaves dry up rapidly, remaining greyish-green in color even though withered. A sticky yellow ooze exudes from the cut ends of the "strings" when an infested stalk is cut. This ooze shows only after a rain or heavy dew. Plants infected as seedlings may be killed outright. Plants infected later may produce a satisfactory crop. The bacteria enter the field on seed or in the bodies of adult overwintering corn flea beetles. Because of the importance of the flea beetle in carrying over the bacteria from one growing season to the next, the severity of the winter

Figure 45. Corn smut.

is one of the factors which controls the amount of Stewarts wilt. A series of severe winters kills most of the flea beetles, so that Stewarts wilt practically disappears. A series of mild winters allows the flea beetle population to build up and once again Stewarts wilt becomes important.

Most early season sweet corn varieties are susceptible to this disease. The later maturing varieties, particularly those developed at this Station, are resistant. Recently, some control has been gained by an intensive spray program using DDT early in the season to eliminate the corn flea beetle. Other control measures are to destroy infected refuse, and deep plowing of stubble in the fall.

Helminthosporium leaf blight, *Helminthosporium turcicum*. This fungus disease shows as a sudden leaf scorch late in the summer following a period of wet weather. The diseased leaves appear as if hit by an early frost. The fungus makes black thread-like growths on the injured tissue. Late planting and poor fertilization usually contributes to infection by this fungus. To help avoid the disease, fertilize the plants properly and keep them in good growing condition.

Root rot, *Gibberella saubinetii*. This disease is caused by a fungus which lives in the soil. The roots are rotted off and the base of the stalk is diseased. Stalks which lose their supporting roots because of this disease may be blown over easily. The diseased stalk usually shows a reddish discoloration when it is split open. There are no control measures except crop rotation and planting on well-drained soils.

Aphids. Aphids may infest both the leaves, *Rhopalosiphum maidis*, and roots of

corn, *Anuraphis maidi-radicis.* They are not usually abundant, and no special control measures have been applied.

Armyworm. In certain seasons this cutworm may be destructive to corn. See Meadow.

Figure 46. Corn earworm.

Corn earworm, *Heliothis armigera.* This is one of our most destructive insects. The moths, which spread about one and one-half inches and are tan with darker markings, arrive in Connecticut each season from more southern areas after which they lay eggs singly on the corn silk. After hatching, the caterpillars feed upon the silk and then the kernels at the tip of the ear. They reach a length of almost 2 inches and vary greatly in color from a light green or pink to tan and dark purplish brown. The head is yellow and the body is variously marked with more or less distinct longitudinal stripes. There are two or three generations each season. The corn earworm can be controlled by keeping the silks dusted with DDT, being careful to start early and to keep new silk growth covered. (See figure 46).

Corn root webworm, *Crambus caliginosellus.* The larvae of this insect and that of a closely related species, occasionally injure corn, especially on sod land, by eating into the side of the stalk just above the surface of the ground. The larvae is about half an inch long and dirty white or gray with dark tubercles. Control is rarely necessary.

Cutworms. Several species which vary greatly in numbers from year to year may injure corn. See Tomato.

European corn borer, *Pyrausta nubilalis.* This insect feeds on a great variety of herbaceous plants. The larvae tunnel in the stalk and ears in all directions, weakening the stalks so that they break over. Breaking-over of the tassels is one of the first signs noticed. The larva is dirty white or gray with black tubercles and is not more than an inch in length when full grown. Adults have a wing spread of an inch or so and are buff to brown in color. There are usually two generations annually. Eggs are laid on the underside of leaves, and the larvae tunnel in the stalks and pupate in the burrows. Second generation larvae and those of the single brooded cornborer live over winter in the stalks and pupate in the spring. (See figure 47). Control by dusting or spraying with DDT or Ryania when half the tassels can be seen in the whorls, and repeat twice at 5-day intervals. See Circular 176.

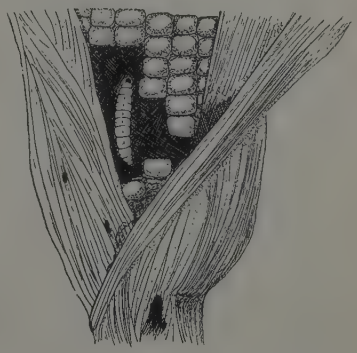

Figure 47. European corn borer.

Flea beetles. The adults of several species of flea beetles feed upon the leaves of corn and, besides eating holes in the leaves, may cause damage by their ability to disseminate Stewarts wilt disease. It is helpful to plant varieties resistant to wilt and to use DDT for control of the beetles.

Grass thrips, *Anaphothrips obscurus.* The leaves of corn are sometimes injured by thrips, which make narrow chain-like markings where they have eaten on the surface. Control is not usually required.

Japanese beetle, *Popillia japonica.* The adults of this colorful insect, frequently cluster at the tips of ears of sweet corn where they feed on the fresh silk. Damage may be

particularly severe during July and August if the cornfield adjoins a large area of turf which is infested with Japanese beetles. They can be controlled by the methods regularly used against the European corn borer.

Leaf miners. The corn leaf miner or spike-horned leaf miner, *Cerodontha dorsalis,* makes a linear mine, usually near the margin or mid-vein. The corn blotch leaf miner, *Agromyza parvicornis,* makes a broad linear or blotch mine near the base of the leaf. These are of minor importance and control measures are not ordinarily needed.

Lesser cornstalk borer, *Elasmopalpus lignosellus.* In some seasons, particularly in dry weather and on light soil, young corn may be attacked by bluish-green, brown-striped caterpillars which feed first upon the lower leaves and later infest the roots and stems. They characteristically form dirt-covered silken tubes which lead away from the stem tunnels in the soil. Control has not been necessary.

Sap beetle. Both the larvae and adults of this small active beetle feed on the ears of sweet corn. The adults frequently make small round holes through the husk to enter the ear. Control measures have not been needed in the past.

Seed-corn maggot, *Hylemya cilicrura.* The maggots of this small fly may infest seed corn in the ground and injure or destroy them so that they do not produce good plants. Damage is much greater in cold, wet weather and with shallow planted seed. See Bean.

Stalk borer, *Papaipema nebris.* Occasionally the larvae of this insect will bore into the stalks of corn, particularly in the marginal rows of a planting. Control is not commonly needed. See Tomato.

White grubs. The larvae of several species of white grubs, which are the immature forms of the common dark colored May or June beetles, may cause injury by feeding on the roots of corn. The grubs are white with brown heads and lie in a characteristic curved position. The eggs are generally laid in grasslands and damage to crops is subsequently greatest when they are planted on land that has recently been taken out of sod. These insects have a 3-year life cycle and most damage occurs the year after the adults are abundant and lay their eggs, which would therefore be during the second year of the life cycle. In the eastern United States, grub years, or years of most damage, will occur in 1957, 1960, and every third successive year. By not planting corn and other susceptible crops on new sod land, most of the injury can be avoided. Treating the soil as for wireworms will control these grubs. See Tobacco.

Wireworms. Seeds, roots, and stems may be fed upon, producing poor plants. Several species of wireworms are involved, which like the white grubs, are more injurious to crops planted on soil which is the first or second year out of sod. See Tobacco.

Cornflower (Bachelor's Button)

Wilt, *Fusarium oxysporum f. callistephi.* A disease similar to aster wilt is caused by the same fungus. The plant wilts and dies. Planting seed in sterilized soil or uninfested soil will help.

Downy mildew, *Bremia lactucae.* Pale green or reddish spots appear on the upper side of the leaves and a soft mold appears on the under side. Leaves soon die. Spraying with zineb at the first sign of infection may prevent spread.

Rust, *Puccinia centaureae.* Reddish-brown pustules appear on the underside of leaves and stems. May be controlled by spraying immediately with ferbam or zineb.

Crown rot, *Sclerotium rolfsii. Rhizoctonia solani.* Plants decline and die. Sclerotia may be present in both cases, but are more likely with the *Sclerotium* fungus. Drenching the soil with mercury bichloride 1:1000 (see p. 78) may help if infection by this fungus has not proceeded too far. In infection by *Rhizoctonia* a soil drench with oxyquinoline sulfate (see p. 5) will halt progress of the disease. Applications may be repeated as necessary.

Stalk borer. See Dahlia.

Cosmos

Stem canker, *Phomopsis stewartii.* Dark brown spots appear on stems which are later grey. These rapidly enlarge and girdle the stem killing the plant. Burning the old stems at the end of the season will reduce the amount of the overwintering stage of the fungus.

Bacterial wilt, *Phytomonas solanacearum.* Sudden wilting of the plant is generally accompanied by a soft rotting of the stem at the ground level. A yellowish ooze of the bacteria appears when the stems are cut. In-

fected plants should be destroyed and cosmos planted elsewhere, since the bacteria are soil-borne. Badly infested soil may be sterilized with formaldehyde. (see p. 4).

Powdery mildew, *Erysiphe cichoracearum.* White powdery appearance of leaves indicates infection by this fungus. Sulfur sprays are indicated.

Aphid. See Chrysanthemum.

Plant bugs. See Meadow and Celery.

Red spider. See Phlox.

Stalk borer. See Dahlia.

Cotoneaster

Leaf spot, *Phyllosticta sanguinea.* Reddish-brown spots with a dark border appear on leaves in this infection.

Control consists of spraying with Bordeaux, ferbam, or thiram.

Fire blight, *Erwinia amylovora.* This bacterial disease causes sudden shriveling of branches, which appear as though scorched by fire. Control may be attempted with use of agrimycin, spraying three times beginning at early bloom, full bloom, and at petal fall with 1 oz. Agri-mycin in 10 gallons of water.

San Jose scale. See Pear.

Crab (Flowering)

For insects see Hawthorn

Leaf rusts, fire blight, and apple scab are common on flowering crab. Bechtel's crab is particularly susceptible to the cedar-apple rust. See Apple.

Cucumber

Anthracnose, *Colletotrichum lagenarium.* This fungus disease shows as small black spots on the leaves. If young plants are attacked, the fruits may turn black and drop off. Diseased older fruits may be covered with irregularly shaped sunken pits filled with pink ooze following rain or heavy dew. The fungus is both soil- and seed-carried and is most serious on cucumbers and melons. It rarely attacks squash or pumpkins. To control this disease, it is essential to use clean, treated seed, use crop rotation, and spray with ziram or zineb.

Scab or pox, *Cladosporium cucumerinum.* This fungus disease appears as small angular dead spots on the leaves. The spots may fall out, giving a tattered appearance to the leaf. The most prominent symptom is the appearance on the fruit of discolored oozing areas which look like insect feeding punctures. These spots dry up leaving small pits covered with olive-gray fungus. This fungus is seed- and soil-borne so that control measures must include the use of clean, properly treated seed, and an adequate crop rotation. At present there are no sprays which will control scab on cucumbers. Spraying with zineb has shown promise for the control of scab on summer squash.

Bacterial wilt, *Erwinia tracheiphila.* Plants with this disease wilt quickly and may dry up so fast that the leaves remain green. When the stem is cut across, a sticky, white ooze may be seen. The bacteria are carried from plant to plant by the feeding of the two-spotted and striped cucumber beetles. Controlling the cucumber beetles will slow the spread of the bacterial wilt. Backyard gardeners may wish to cover their plants with cheesecloth to keep out beetles. Planting extra seeds so that diseased plants may be removed at once will leave sufficient plants for a crop. Certain American varieties of cucumbers, such as Chicago Pickling, are somewhat resistant to bacterial wilt. Bacterial wilt is not seed-borne.

Angular leaf spot, *Pseudomonas lachrymans.* This soil- and seed-borne bacterial disease shows as small, reddish-brown, angular leaf spots. It is most likely to appear during wet weather. After rain or heavy dew, the spots look water soaked. Angular leaf spot may kill young plants, or severely infected older plants. Usually it does not cause fruit symptoms. To avoid this disease, use clean, properly treated seed, and a 2-year crop rotation.

Figure 48. Cucumber white pickle.

Mosaic. A plant with mosaic is stunted, has mottled leaves, and produces small, light-colored fruits with irregular green bumps. These fruits are called "white pickles." The disease is caused by a virus which is carried from plant to plant by aphids. The virus infects a great number of crops and weeds, so that the aphids usually become contaminated from infected weeds growing near the

cucumber field. To slow down the spread of the disease, keep down the aphid population and destroy weeds along the edge of the field. Pull up and destroy the first few plants which appear to have symptoms. Before destroying weeds and pulling up plants, it is best to kill the aphids on them first. Otherwise these aphids will move from the dying plants into the field. Mosaic-resistant cucumber varieties are now available.

Downy mildew, *Pseudoperonospora cubensis.* The first symptoms are light yellow leaf spots which are downy purple underneath. These spots spread rapidly killing the foliage and whole plants outright. This fungus disease does not appear very often in Connecticut. When it does show up, however, it may wipe out whole fields within a few days. The fungus is favored by cool, wet nights, and warm, humid days. When these conditions prevail, the plants may be protected by spraying with zineb, or copper fungicides. Good spray coverage is essential for control of mildew with fungicides. To avoid plant stunting, the spraying should not begin until the plants are at least 18 inches across. Control has not been satisfactory during prolonged periods of cool weather. Cucumber varieties resistant to downy mildew are now available.

Powdery mildew, *Erysiphe cichoracearum.* Late in the summer this fungus will form a white powdery growth on older leaves. This disease is relatively unimportant, but may cause some loss to growers of summer squash. Karathane may be used to control this disease, but usually no control measures are needed.

Melon aphid. See Melon.

Melonworm. See Melon.

Pickleworm, *Diaphania nitidalis.* This insect occasionally causes damage to late maturing crops. The white, yellowish or greenish larvae have yellow brown heads and are about three-fifths of an inch long when mature. They burrow in the bud, blossom, vines and fruit. Special control is not generally needed.

Spotted cucumber beetle, *Diabrotica undecimpunctata.* This is a minor pest which occasionally causes injury. It is somewhat larger than the striped cucumber beetle, and the wing covers are greenish yellow marked with 12 black spots varying in size and arranged in three transverse rows. The life history and control is similar to that of the striped beetle. See striped cucumber beetle.

Striped cucumber beetle, *Acalymma vittata.* This is the most destructive insect pest of cucumbers. The beetles hibernate under trash or in the ground, and appear upon the plants as soon as the seed germinates. The greatest injury occurs to the young plants, and the beetles feed usually on the underside of the leaves.

The beetles are one-fourth of an inch or less in length, with thorax and wing covers yellow, with three black longitudinal stripes on the wing covers, and with a black head. The eggs are laid the last of June on the surface of the ground or in crevices in the soil, and oviposition continues for about a month. The eggs hatch in about a week and the young larvae work their way downward along the main stem, where they burrow into it, causing much injury, especially by inoculating the plants with bacterial wilt. A full grown larva is one-third of an inch long, slender and white with brown head, thoraxi anal plates. There is only one generation annually.

They can be controlled by dusting or spraying with rotenone, pyrethrum, or methoxychlor, starting (see figure 49) as soon as the first beetle is seen and repeating two or three times as necessary.

Figure 49. Striped cucumber beetle.

Currant

Anthracnose, *Pseudepeziza ribis.* The leaves are most commonly attacked but this disease also occurs on the fruit. The symptom on leaves is a scattered pattern of small red-brown to purplish spots that ooze masses of pink spores on the underside of the leaf. Our earlier work on this disease showed that early season sprays of Bordeaux gave satisfactory control. Ferbam can be substituted for Bordeaux with equally good results. Red and white varieties are most susceptible.

Cane blight, *Botrysphaeria ribis.* This disease occurs on the stems, girdling and killing them. On the dead stems small, black fruiting pustules are produced. This is not an important disease in Connecticut, and if it does occur, cutting and burning infected canes will give control.

Blister rust, *Cronartium ribicola.* All species and varieties of currants are susceptible to one stage of the rust causing white pine blister rust. The rust shows as flat bright orange spots on the leaves appearing in midsummer. Red currants are not very susceptible but black currants are very susceptible. On currants the rust is of minor importance, but owing to the fact that they are an alternate host for the white pine blister rust, the growing of black currants is prohibited in Connecticut and red and white currants are restricted to areas not adjacent to pine stands. A permit must be issued before they may be legally planted.

Cluster cup rust, *Aecidium grossulariae.* This is another heteroecious rust occurring on currant and is mentioned only because it might be mistaken for blister rust. This rust produces small white toothed cups filled with orange spores on the underside of the leaf, in contrast to the flat bright orange spots of blister rust. It is of no importance on currants.

Currant aphid, *Capitophorus ribis.* This aphid is usually found on the underside of the tender terminal leaves which become more or less curled or blistered by it. Glossy black eggs on the twigs of the new growth carry the insect through the winter. These eggs hatch soon after the first leaves unfold. Many generations during the summer are born alive, most of them females without wings. When the aphids become overcrowded, winged females develop and migrate to other currant plants. The distorted and curled leaves often turn red and drop. After midsummer the aphids become less abundant on account of natural enemies, but enough females survive to lay eggs on the twigs in October.

A dormant spray of dinitro-o-cresol has controlled these aphids. Sprays of malathion may be applied to the undersides of the leaves as soon as the aphids appear.

Currant borer, *Ramosia tipuliformis.* Certain stems that appear to be unthrifty and finally die usually have the center or pith tunneled by the larva of this insect. The eggs are deposited singly on the bark. The full-grown larva is about half an inch in length and is white with brown head and legs. The adult is one of the clear-winged moths with wing spread of about three-fourths of an inch. The wings are transparent with opaque purplish margins. There is one brood each year, and the moths emerge in June. Sickly canes may be cut off and burned before June 1.

Currant fruit fly, *Epochra canadensis.* This insect often causes serious injury to currant and gooseberry. The larva or maggot infests the berries, which may hang on the bushes or drop to the ground. There is only one brood each year, and the winter is passed in the pupa stage in the ground. The adult fly is about the size of the house fly, but is pale yellowish in color with banded wings. Two or three sprays or dusts of rotenone at weekly intervals starting when the blossoms fall should control this pest.

Currant stem girdler, *Janus integer.* This insect is a sawfly that lays an egg in May in the new shoot and girdles or cuts it partly off an inch or less above the egg. These tips break off altogether or hang from the canes. On the hatching of the egg, the young larva burrows downward in the pith to a distance of not more than 6 inches. About September 1, the larva reaches maturity, cleans out the lower end of the burrow, and eats a passageway to the outer bark. It passes the winter as a larva in the burrow and pupates in the spring. There is one brood each year. The only known remedy is to clip off and burn the tips of the canes.

Four-lined plant bug, *Poecilocapsus lineatus.* This bug lays eggs in the soft stems. They hatch about the middle of May and the young bugs suck the sap from the tender leaves. They molt five times and when mature, about the middle of June, they have wings and are nearly one-third of an inch in length. They are yellow, marked lengthwise on the back with four black stripes alternating with three green stripes. The injury to the leaves consists of sunken areas around the punctures. These areas later appear as

Figure 50. Four-lined plant bug on currant.

circular transparent spots and finally as circular holes. This insect injures the new leaves of many different kinds of annual and perennial plants and shrubs. There is only one generation each year. (See figure 50.) The nymphs can be destroyed by spraying with malathion or nicotine sulfate and soap.

Gooseberry spanworm. See Gooseberry.

Figure 51. Imported currantworm.

Imported currantworm, *Nematus ribesii.* The adult sawflies emerge when the currant leaves first unfold, and lay white elongate eggs end to end in rows along the veins on the underside of the leaves of currant and gooseberry. The eggs hatch in a week or 10 days, and the larvae feed upon the leaves, becoming full-grown in from 2 to 3 weeks, when they are about three-fourths of an inch in length. During most of the feeding period the larvae are grayish-green, covered with black spots but at the last molt, they lose the black spots and are a uniform green. They pupate beneath leaves or trash on the ground. A second brood of adults appears in late June or early July and lays eggs for a second brood of larvae. The first brood causes most of the injury; the second is of little account. (See figure 51.) The remedy is to spray with rotenone when the first brood larvae begin to feed. If treatment seems necessary when the fruit is near maturity, pyrcthrum may be used.

San Jose scale. See Apple.

Scurfy scale. See Pear.

Two-spotted mite. This mite may infest currants seriously, especially if infested weeds are growing near the bushes. One or two applications of Aramite or malathion may be required to eliminate this mite.

Currant (Yellow Flowering)

Aphids. The Missouri currant sometimes becomes infested by *Aphis sanborni,* but a satisfactory control is obtained by thoroughly spraying with nicotine sulfate and soap, or with pyrethrum and soap.

Cyclamen

Foliar nematodes, *Aphelenchoides fragariae.* Leaves and stems collapse, or the plant may not produce buds properly. It is difficult to determine macroscopically, but laboratory determination is simple. The nematodes may be carried in the dormant buds of the corms, or in the soil. Use of clean corms and clean potting soil is advisable.

Black vine weevil. The grubs devour the roots of cyclamen. See Taxus.

Cyclamen mite, *Tarsonemus pallidus.* This translucent, microscopic mite often infests the new leaf and blossom buds, causing them to become swollen and distorted. Infested plants give no satisfactory blossoms. Cyclamen mite is not easily controlled when mature plants are badly infested. Malathion used as a spray repeatedly from the time two to four leaves have developed until the plants are mature may be expected to give good results. Systemic insecticides are useful when used under controlled conditions. In addition aerosols may be employed as a supplement to systemics or spraying in greenhouses. Hot-water treatment at 120° F. for 15 minutes controls cyclamen mite on plants before reaching the flower-bud stage.

D

Daffodil

Blast. This trouble is fairly widespread and characterized by the appearance of flower buds which turn brown and dry up before opening. Cause is unknown. Bulbs behaving so year after year can be dug and discarded.

Ring disease, *Ditylenchus dipsaci.* (Nematodes). Plants may fail to grow in spring, or leaves may be abnormal and twisted with small yellowish lumps called "spikkels" which contain many nematodes. Flowers are not produced. Bulbs when cut across show discolored rings (hence the name). Yellowish pockets in scales contain numerous eelworms. Hot-water treatment of bulbs gives reasonably good control (110-115° F. with 3 hours for small bulbs and 4 hours for large ones). Planting in clean or sterilized soil is indicated. The disease may be reduced by removal and destruction of infected plants and bulbs and some of the soil around them.

Bulb and root rots, *Fusarium* sp., *Sclerotium rolfsii.* Plants may develop poorly or may not grow at all. Examination of bulbs shows rotted areas: some with white mold in which are sclerotia if the latter fungus is involved. Roots are brown and rotted. White or pinkish mycelium or spore masses may be found when *Fusarium* is the pathogen. Roguing infected bulbs and removing soil from the area where the bulbs were planted is about all one can do. Narcissus should not be planted in an infected location for 2 or 3 years.

Dahlia

Powdery mildew, *Erysiphe cichoracearum.* White powdery appearance of leaves indicates presence of this fungus. Sulfur sprays or dusts will control it.

Bacterial wilt, *Phytomonas solanacearum.* Sudden wilting and death of the plant is characteristic of this disease. Cut stems reveal yellowish bacteria oozing from vascular bundles. Bacteria overwinter in soil, so that soil sterilization and removal of all infected plant parts is essential for control.

Wilt, *Fusarium* sp. or *Verticillium dahliae.* Wilting of a single branch or entire plant with recovery at night is usually the first sign of infection by these fungi. The plant may remain alive for a short time but eventually succumbs. Cut stems reveal dark discoloration in the vascular bundles. The fungus lives in the soil and in the tubers, so that planting healthy tubers in disease free soil helps prevent these diseases.

Stem rot, *Sclerotinia sclerotiorum.* Sudden wilting of the old plant accompanied by rotting at the soil level by a white mold, often with black sclerotia within the stem, are typical of this disease. Diseased plants should be destroyed at once and another planting area used unless soil is sterilized with mercuric chloride. (See p. 78.)

Grey mold, *Botrytis cinerea.* Buds and flowers rot and may be covered with a grey mold. Prolonged cool wet weather favors this disease. No known fungicide gives good control.

Mosaic, stunt. A virus disease which appears as a mottling in leaf tissues or pale green bands along midribs and larger veins, and leaves are generally dwarfed or distorted. Infected plants appear stunted and are small and bushy. Tubers of virus infected plants are shorter and thicker than normal with reddish-brown necrotic spots inside. Prompt destruction of infected plants avoids spread to healthy plants by aphids. Insect control helps prevent spread. Dwarfing of dahlias may also be due to excessive feeding of leafhoppers or aphids or the effect of European cornborer or thrips. If this is the case, plants will resume normal growth after insects have been controlled.

Spotted wilt. Conspicuous light green or yellow concentric rings appear in leaves. Plants are not dwarfed. This virus disease is present in tomatoes, peppers, zinnias, and numerous other hosts.

The disease may be reduced by roguing and destruction of affected plants as well as control of thrips, aphids, and leafhoppers.

Foliar nematodes, *Aphelenchoides ritzema-bosi.* Dark spots start on undersides of leaves spreading to the upper surface and involving the entire leaf. Leaves brown and hang down progressively from the bottom of the plant upwards.

Nematodes may pass over to weed hosts like mums or asters, so that care is advisable as to choice of plants to follow in infested areas, and soil sterilization (see p. 4) may be necessary. Removing and burning of infested parts is advisable.

Asiatic garden beetle. See Lawns.

European corn borer. The second generation of this pest lays its eggs on dahlias and sometimes injures them seriously. See Corn. Weekly applications of DDT dust during August will prevent serious damage to dahlias.

Giant hornet. This is the largest hornet occurring in Connecticut, and many individuals are more than an inch in length. The general color is dark brown with a broad band of orange yellow on the rear margin of each abdominal segment. This hornet nests in hollow trees and gathers wood fibers to be used in constructing the nest. Sometimes it removes the bark from twigs of lilac, arborvitae, and other shrubs and trees, thus girdling them. There is no practical control by sprays.

Potato leafhopper. Sucking of the plant juices causes a blanching of the dahlia foliage. DDT or malathion may be expected to give good control of the pest. August treatments may also control the European corn borer.

Figure 52. Stalk borer in dahlia.

Stalk borer, *Papaipema nebris.* This borer infests an occasional stalk of many kinds of herbaceous plants and it frequently causes rather severe injury to dahlia. As a rule its presence escapes notice until the plant begins to wilt. Then it is too late for the plant to recover. The larva tunnels up and down inside the stem, and the top portion usually wilts and later dies. There is one annual generation, and the moths emerge in September and October and lay eggs on the stalks of their food plants, in which stage the insect passes the winter. The eggs hatch in May or early June, and the young larva begins to feed upon the leaves of the nearest food plant, and later tunnels in the stem. The mature larva is nearly 1½ inches in length, grayish brown with one white corsal stripe and two white lateral stripes on each side. On the front half of the body the lateral stripes are interrupted, and the lower brown stripe extends forward onto the side of the head. (See figure 52.)

Burning all the old stalks and the weeds around the field helps control this insect. Methoxychlor dust has controlled this pest in other crops. Dusting is necessary in June.

Tarnished plant bug. This bug punctures the buds and new shoots, causing deformity. See Celery.

Dandelion

Leaf spot, *Ramularia taraxaci.* Brown spots with purplish borders with a whitish fungus growth on the underside are characteristic. Sprays of Bordeaux may help control it.

Powdery mildew, *Sphaerotheca castagnei.* White powdery appearance of leaves indicates presence of this fungus. Sprays of sulfur control the disease.

Aphids. The dandelion aphid, *Macrosiphum taraxaci,* the melon aphid, and the green peach aphid and probably other species infest the dandelion crop. Spraying with nicotine sulfate and soap will kill them.

Chrysanthemum leaf miner. This leaf miner sometimes infests dandelions. See Marguerite.

Daphne

Leaf spot, *Gloeosporium mezereum, Marssonina daphnes.* Brown spots on both sides of the leaf are accompanied by leaf drop. Twigs may be attacked. Sprays of thiram, ferbam, or Bordeaux should be accompanied by pruning out infected branches and burning. Removal of infected fallen leaves helps reduce the disease.

Collar rot, *Rhizoctonia solani.* Cuttings rot or plants wilt and die from root or collar rot caused by this fungus. Oxyquinoline sulfate solution (see p. 5) applied to the soil in place of a watering will be helpful if plants are not too heavily infected. Rooted cuttings may be treated thus but if roots have not yet formed, infected cuttings should be destroyed. Use of sterilized rooting medium and potting soil will prevent this trouble.

Winter killing. Late winter and early spring daphne tips may appear discolored: the tips of the leaves burned. This unsightly condition can be caused by ice formation on the leaves or windburn and may be coupled with root infection by the collar-rot fungus, improper nutritional balance, and growing too late in the season with the resultant unhardened growth. Verticillium wilt infection may or may not be present in the plant. Laboratory diagnosis is indicated.

Crown or stem rot, *Sclerotium rolfsii.* Wilting and death of infected plants is accompanied by whitish mycelium on the base of plants and sometimes on the surface of the ground, in which may be found the light to dark brown sclerotia.

This disease may be controlled by roguing infected plants and removing infested soil to a depth of at least 3 inches, replacing with clean soil and clean plants, preferably of a kind not susceptible to these fungi.

Delphinium

Blacks. Leaves and flowers are badly deformed, leaves are brittle and thickened with black or brown spots or streaks. This trouble is caused by cyclamen mites.

Black leaf spot, *Phytomonas delphinii.* Irregular shiny black spots appear on the upper surface of the leaves, particularly during cool wet seasons, showing first on the lower leaves. Removal and burning of old plant parts in the fall and spraying the crown of the plant and the soil around it with mercury bichloride 1:1000 (see p. 78) in the spring may help.

Bacterial blight, *Erwinia phytophthora.* Irregular black discoloration and softening of leaves and stem which may extend nearly to the ground. When the stem is split, masses of bacteria ooze out and black streaking shows inside. The bacteria appear to dissolve the cell membranes and the affected tissues, and give off a foul odor. The plants may be stunted or killed back severely. The causal

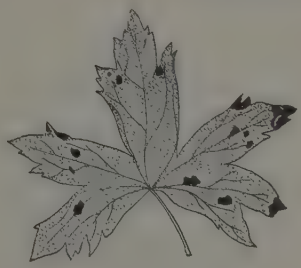

Figure 53. Bacterial leaf spot on delphinium.

bacteria appear to be carried both in the seed and in the soil, but are usually lethal only under very moist conditions. Excessive watering or irrigation intensifies the disease. Stem cracking at the ground level also provides a means of entry for the bacteria. Perhaps a soil treatment with Agri-mycin (1 oz. in 10 gallons of water) could be tried on an experimental basis, pouring the solution on as a soil drench in lieu of watering. This treatment should be considered purely experimental.

Crown rot, *Sclerotium delphinii.* Yellowing of lower leaves followed by wilting and death of the rest of the plant are symptoms of this disease. A white cottony mass of mycelium may be growing around the crown or on the soil near the crown and distinguishes this crown rot from others. In this fungus web may be found the whitish to cream color or buff or reddish-brown seedlike sclerotia the size of a pinhead. No control is known other than roguing and destroying all infected plant parts and removal of top soil around the plant. New soil may replace sclerotia-filled soil. A soil drench of corrosive sublimate 1:2000 (see p. 78) three times at weekly intervals may help if plants are not too far gone. Soil sterilization with formaldehyde before planting clean plants has proven successful, but all plants in the vicinity must be removed before treatment. Otherwise they will be killed by formaldehyde.

Crown rots by various organisms, *Diplodina delphinii, Fusarium oxysporum, f. delphinii, Diaporthe arctii.* Determination of the fungus is unimportant as these diseases occur infrequently. Removal and destruction of diseased plant parts is the only known control.

Basal rot, *Rhizoctonia solani* and *Pythium ultimum* or *P. debaryanum.* Microscopic identification of these fungi enables one to use oxyquinoline sulfate solution (see p. 5) as a soil drench around infected plants.

"Greens" or stunt. Aster yellows virus. Plants may be dwarfed with small leaves showing mottling or chlorosis. Flowers are characteristically green or flower parts may be leaf-like. A bunchy flowerhead is typical. This virus is spread by leaf hoppers and has many plant hosts: aster, ragweed, chrysanthemums. Control consists of roguing all infected or suspicious plants and spraying for control of leafhoppers.

Powdery mildew, *Erysiphe polygoni.* White mealy spots that may envelope the whole leaf are powdery mildew. Sulfur sprays or dusts may be applied for control. Afternoon applications are most effective.

Dewberry

Blackberry knot gall, *Diastrophus nebulosus.* This gall occurs on the stems of dewberry and blackberry. It contains many larval cells and varies from 1 to 3 inches in length, and from 1 to 1½ inches in diameter. It is often deeply furrowed lengthwise and when first found is dark green, but later it turns to red and brown. No method of control is known other than removing and burning the galls.

Dogwood

Leaf spot, *Septoria corni.* A brown spot with a purple border appears on leaves any time during the season. Another leaf-spotting fungus, *Phyllosticta cornicola* produces blood-red spots with pale centers on the leaves. Small black fruiting bodies are sometimes found in the centers of these spots. Control of both fungi may be obtained with sprays of ferbam, thiram, or Bordeaux when leaves are half grown and again when full grown.

Spot anthracnose, *Elsinoë corni.* Small round purple dots are characteristic of this fungus. It has not been reported in Connecticut. Captan sprays are reported to give good control when applied as delayed dormant and "petal" fall sprays.

Bleeding canker, *Phytophthora cactorum.* A generally unthrifty appearance of the tree may be the first sign of infection by this fungus. It shows as a sunken area in the bark from which may ooze a reddish-brown fluid. The bark eventually sloughs off revealing wood with blue-black or reddish-brown streaks below. Twigs and branches on the side of the tree above the canker die first, but the entire tree will die when the canker has girdled the trunk. Cutting out infected wood back to live normal-colored sapwood should be followed by painting over the wound with Bordeaux paint or any other good tree paint.

Twig blight, *Myxosporium nitidum. Sphaeropsis* sp. Both of these organisms can cause a dieback of dogwood tips, particularly on trees not in good condition. No spray program has been worked out for control of these fungi, but dichlone applied just before "flowers" open and after "petals" fall might give good results.

Cottony maple scale. This insect occasionally infests the leaves of flowering dogwood. See Maple.

Dogwood borer, *Thamnosphecia scitula.* The larva of this moth is a borer under the edges of bark of the flowering dogwood, particularly around wounds and mutilations. The larva is white with a pale brown head. The adult moth has a wing spread of about an inch; the wings are transparent with blue-black margins, the thorax and abdomen are blue-black, with narrow yellow rings on the second and fourth abdominal segments. Both the dogwood borer and the flatheaded borer deposit eggs in cracks in the bark. Avoiding mechanical injury reduces the chances of infestation. Newly set trees may be protected by wrapping the trunk with heavy paper or burlap. When trees are pruned, the cut surfaces may be protected by tree paint. Painting or spraying the trunk with DDT spray about once a month starting in June has helped control borers in our experiments.

Dogwood club gall, *Mycodiplosis alternata.* This is a tubular swelling containing a larva, occurring on the small twigs, often killing them back for several inches. The adult is a small fly or gall midge emerging in May or June. No control has been developed.

Dogwood twig borer, *Oberea tripunctata.* The larva of one of the small long-horned beetles is a borer in the terminal twigs of several species of dogwood. The eggs are laid in June and July, hatch in about 10 days, and the young larvae tunnel downward in the twig, making several openings through the bark so that the frass may be thrown out. The twig is girdled above and below where the egg was deposited. The winter is passed in the burrow by the full-grown larva and

pupation takes place in the spring. There is apparently one generation each year. Cutting and burning the infested twigs will help control this insect. DDT spray applied to the terminal twigs about June 15 and again a month later might be helpful.

Flatheaded borer, *Chrysobothris femorata.* Eggs are deposited on the bark, and the larvae make irregular tunnels under the bark. When feeding is completed they bore into the wood to pupate. The larvae are white with a flat head and about an inch long when fully grown. The adult is a wedge-shaped metallic colored beetle about one-half inch long. For control, see dogwood borer above.

Lecanium scale (terrapin scale). See Maple.

Mulberry whitefly. See Mulberry.

Oystershell scale. See Apple.

San Jose scale. See Apple.

Douglas fir

Needle cast, *Rhabdocline pseudotsugae.* The first symptoms of this disease usually pass unnoticed as slightly yellow spots on needles of the current year's growth. In the spring the spots become reddish-brown and are very noticeable. By July infected needles have fallen off and are ready to produce the spores that will infect the current year's growth. Trees that have been infected over a period of years present a thin appearance with usually only one year's needles at the tips of the branches. Three sprays of Bordeaux, plus a spreader, on the new growth as it develops during late May and June about 2 weeks apart should help control this disease. Another fungus, *Adelopus gäumanni,* causes a needle cast of Douglas fir. The same control measures apply for both diseases.

Dutchmans-pipe

Pipe vine caterpillar, *Laertes philenor.* Wherever the Dutchmans pipe vine is grown, the leaves may be devoured by brown non-hairy caterpillars, with two rows of coral red dots along the back. When mature, the caterpillar may reach a length of 2½ inches, and fleshy filaments are borne on each end of the body. The adult is the blue swallowtail butterfly which has a wingspread varying from 2½ to 3½ inches. The forewings are brownish black, and the rear wings are dark greenish blue, with white marginal spots or lunules. Spraying the leaves with DDT is the remedy.

E

Eggplant

Verticillium wilt, *Verticillium alboatrum.* The first symptom of eggplants infected with wilt is the wilting of leaves during the heat of the day, and recovery as the day cools. Finally, these leaves wither and fall off. The diseased plant is usually stunted. The inside of the stem is discolored. Verticillium, the fungus which causes this disease, is seed-borne and may live in the soil for many years. The fungus attacks a great number of other plants, including potatoes, tomatoes, snapdragons, and maples. The only ways to avoid the disease is to use clean seed, and plant on soil with no history of Verticillium wilt.

Phomopsis blight, *Phomopsis vexans.* This disease shows as light colored leaf spots, and as a light brown spot rot on the fruit. Young plants may be killed outright. Infected fruits may rot completely. The fungus which causes this disease is soil- and seed-borne. The spread of the disease is favored by warm, wet weather. Use clean, properly treated seed and a 4-year crop rotation.

Colorado potato beetle. This beetle in both the larval and adult stages feeds upon eggplant. See Potato.

Cutworms. See Tomato.

Pepper maggot. These maggots may also feed in the fruits of eggplant. See Pepper.

Potato aphid. This aphid sometimes feeds on eggplant. If abundant, they can be controlled with malathion.

Potato flea beetle. The potato flea beetle also feeds on the leaves of eggplant. See Potato.

Tobacco worm. The tobacco and the tomato worm both occur in Connecticut and occasionally feed upon eggplant. See Tobacco and Tomato.

Elm

Black spot, *Gnomonia ulmea.* The first indication of this trouble is usually the falling of yellowed leaves on which may be found small black raised spots. Complete defoliation of the tree can occur in a fairly short time. Three sprays of Bordeaux, ferbam, or thiram applied when leaves are half grown, full grown, and 2 weeks later will control the disease. Fallen leaves should be gathered and burned.

Figure 54. Black spot on elm.

Dutch elm disease, *Ceratostomella ulmi.* Wilting and dying of leaves on small to large branches is followed by the death of the entire tree. Reddish-brown streaks are found in the sapwood. The causal fungus is carried in the mouth and on the bodies of the elm bark beetle, and trees are inoculated during feeding. Sprays of DDT to control the beetle will help to prevent infection. Soil treatment with oxyquinoline benzoate will also be helpful, although will not give 100 per cent protection. Removal of dead trees or debarking fallen or dying trees before spring will kill the hibernating beetles. Spraying the dead trees or logs with DDT in oil will kill beetles as they emerge. For more complete information write for the Special Circular "Combating the Dutch Elm Disease."

Dieback, *Dothiorella ulmi. Sphaeropsis ulmicola.* Twig and branch dieback of elm can involve the entire tree. Cultures are necessary to distinguish this disease from Dutch elm disease unless the fungus is found fruiting on the wood. Pruning out dead wood well back of infected area can arrest this disease.

Wilt, *Verticillium dahliae.* Symptoms are similar to Dutch elm disease, and only cultures can determine the causal fungus. The disease usually spreads upwards from the roots. When trees wilt considerably, it is better to cut them down and burn them, including as many roots as possible.

Slime flux. When sap pressure inside the tree becomes too great, the sap bursts through the bark in the weakest place and drips down the trunk. Wild yeasts, insects, and fungi are apt to be associated with this sap, and it has a fermented odor. The loss of sap will not harm the tree, but it will kill the bark over which it flows. A short length of pipe driven into the tree at the point of eruption and extending out beyond the bark will enable the sap to drip onto the ground, thereby avoiding bark injury.

Powdery mildew, *Microsphaera alni. Phyllactinia corylea.* Several species of mildew infect elm leaves, turning them yellow. Spraying is usually unnecessary.

Canker worms. The canker worms often partially defoliate elm trees. See Apple.

Elm borer, *Saperda tridentata.* These are one-half inch long gray-brown beetles with brick-red bands and black spots. The beetles attack weakened trees, laying their eggs on the bark in June. The one-inch long white larva burrows into the inner bark and sapwood. Winter is passed in this stage. Spraying with DDT in June will be helpful in controlling the adults and hatching larvae.

Elm leaf beetle, *Galerucella xanthomelaena.* This insect is capable of causing serious injury to elm trees by devouring the leaves. The beetles hibernate in attics, belfries, and other protected places, and they emerge and fly into the trees as soon as the new leaves unfold. They feed somewhat, eating round holes through the leaves. They mate, and late in May the females lay yellow eggs in clusters on the underside of the leaves. These eggs hatch early in June and the grubs or larvae eat away the under surface, leaving the network and upper epidermis, becoming mature about the middle of July, when they descend to the ground and transform to bright yellow pupae on the surface of the ground around the base of the tree. Ten days later the beetles emerge and fly into the trees. Some may lay eggs, but there is only a partial second brood in Connecticut, and the beetles go early into their winter quarters. This beetle is about one-fourth of an inch in length, and buff with an olive-green stripe along the outer margin of each wing cover. The best protective measure is to spray thoroughly the under surface of the leaves early in June with lead arsenate, using about 5 pounds in 100 gallons of water. DDT spray is effective but its continued use may encourage mites. (See figure 55.)

Elm scurfy scale, *Chionaspis americana.* This is a whitish pear-shaped scale that sometimes occurs on the twigs and branches of elm trees. It passes the winter in the egg stage and there are two generations each year. The control measures are dormant spring applications of miscible oil, or July applications of malathion.

European bark beetle, *Scolytus multistriatus.* A reddish-black beetle one-tenth of an inch long attacks weakened and dying elm trees, especially those affected with Dutch elm disease, which it transmits from diseased to healthy trees. Eggs are laid in galleries in the sapwood. The young tunnel outward at right angles to the egg chamber. Small round holes appear in the bark where adult beetles have emerged. A special DDT spray applied

Figure 55. At left, larva of the elm leaf beetle; center, European elm scale; and right, spiny elm caterpillar.

early in the spring before the leaves come out leaves a deposit on the bark and helps prevent feeding by the beetles. This DDT spray requires a thorough coating of the smaller branches with a 2 per cent DDT emulsion applied by a power sprayer, or a 10 per cent DDT emulsion applied by a mist-blower. Full discussion of the problem is given in the Special Circular, "Combating the Dutch Elm Disease."

Figure 56. Leopard moth caterpillar damages elm, (see Apple, page 22).

European elm scale, *Gossyparia spuria.* This is a soft-bodied unarmored scale, chocolate brown with marginal fringe of white wax, that occurs in the crevices of the bark of trunk and lower branches. It is oval in shape and about one-tenth of an inch in length. The young appear in June and there is only one generation each year. See figure 55. A dormant spray with miscible oil will control this scale, or August sprays of malathion may be used.

Gypsy moth. The caterpillars feed upon elm leaves. See Oak.

Spiny elm caterpillar, *Nymphalis antiopa.* This is the larva of the mourning cloak butterfly that lays eggs in cylindrical clusters on the small twigs of elm poplar and willow. The larvae hatching from the eggs feed together in a cluster and soon strip the branch. The full-grown caterpillar is about 2 inches in length, black sprinkled with small white dots, giving it a hoary or grayish appearance. Along the back is a row of red spots somewhat diamond-shaped. Each segment bears several black branched spines arranged approximately in transverse rows. The butterfly has a wingspread of 2½ to 3 inches and is purplish brown with yellow wing margins. The cocoon, suspended by the tail, is about an inch in length and has a row of spine-like projections along the ventral surface. There are two annual generations. Clipping off the twig as soon as caterpillars are noticed, burning or crushing the caterpillars, and spraying with DDT or lead arsenate are the measures of control. (See figure 55.)

Terrapin scale. See Maple.

Twig injury by squirrels. Squirrels often cut the small twigs of elm trees in large numbers during the latter half of May. Most of these are the flowering twigs and the brown seeds are then nearly ripe. Presumably the squirrels feed upon these seeds, but the twigs are too slender to bear the weight of the squirrel; so he cuts them off and they fall to the ground where he goes to eat the seeds. There is no remedy other than to provide nuts or other food for squirrels at this time.

White-marked tussock moth. The larvae feed upon elm foliage. See Horsechestnut.

Woolly elm aphids. Several species of woolly aphids attack elms, causing leaf roll, rosette, leaf gall, or knotty growths on the bark. Spraying has been successful if done before the leaves are curled or galls formed. Malathion or lindane have been the preferred materials.

Endive

Aphids. A number of species of aphids as the bean aphid, pea aphid, and lettuce aphid feed upon endive in Connecticut. Early use of malathion should give control if such is needed.

Euonymus

Crown gall, *Agrobacterium tumefaciens.* Roots and running stems may show galls of considerable size. If infection is heavy, plants may be destroyed. If there are only a few galls, affected stems may be removed and burned.

Powdery mildew, *Microsphaera euonymi* and *M. alni.* Powdery appearance of leaves indicates presence of one of these fungi. Sulfur sprays or dusts applied in mid-July before mildew appears will control the disease.

Aphids. The bean aphid *(Aphis fabae)* occurs on Euonymus and probably other species also. See Beans.

Cottony maple scale. This scale infests Euonymus. See Maple.

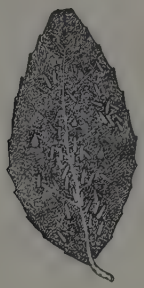

Figure 57. Euonymus scale.

Euonymus scale, *Unaspis euonymi.* This is perhaps the most serious pest of Euonymus, and it often kills entire branches. It also infests bittersweet and pachysandra. The female shells are gray and pear-shaped, and the male shells are smaller, narrower, and whiter. There are probably two broods each season, and the winter is passed in a nearly mature condition; eggs are formed during May and hatch later in the month. All badly infested and injured branches may be cut and burned. (See figure 57.) Spraying with malathion in early July and early September is the control suggested. See Bulletin 578.

San Jose scale. See Apple.

Eupatorium
(Blue Mistflower, Perennial Ageratum)

Powdery mildew, *Microsphaera alni.* This fungus causes a whitish bloom on Eupatorium, lilacs, oaks, azaleas, and many other plants. Control is better started before the fungus appears (usually in mid-summer) but may be applied after the mildew is first noticed. Spraying with sulfur will check it, but originally affected leaves will remain mildewed.

Crown rot, *Sclerotium delphinii.* Plants or branches wilt and die. A white cottony mycelium can be found on the stems at ground level and may contain the small seed-like sclerotia. Roguing and burning infected plants and removal of infested soil is advisable, replacing it with clean soil and replanting with non-susceptible species is suggested.

Rust, *Puccinia eleocharidis.* This commonly shows as orange-reddish pustules on undersides of leaves. Alternate host is a rush. Spraying before infection occurs or removal of the alternate host will give control. The infection will not spread on the Eupatorium. Bordeaux, ferbam or zineb may be used.

Canker, *Botrytis cinerea.* Wilting is due to rotting of stem, beginning as a canker low down on the stem when plants are crowded and weather cool. Improved ventilation by thinning plants every spring usually prevents this trouble.

Exochorda

Gall mite, *Eriophyes* sp., A species of mite is responsible for small galls on the leaves, usually on the upper surface. Probably this mite can be controlled by a spray of Aramite or malathion on the crawling stage of the mites.

F

Fern

Fern aphid, *Idiopterus nephrelepidis.* This black aphid often infests the under surface of the fronds of the Boston fern, though seldom causing severe injury. The remedy is to spray with nicotine sulfate and soap, or malathion, or if the plants are in small pots, to dip them in the mixture.

Fern scale, *Pinnaspis aspidistrae.* This armored scale infests the Boston fern in greenhouses and dwellings. The female scale is about one-twelfth of an inch in length, pear-shaped, light brown in color, and the male is smaller, pure white, narrow with parallel sides and with a distinct longitudinal ridge. Both occur on the underside of the fronds. This insect may be kept in check by spraying with malathion, repeating if necessary.

Figure 58. Hemispherical scale.

Hemispherical scale, *Saissetia hemisphaerica.* This very convex brown hemispherical unarmored scale often infests the stems and fronds of Boston and other ferns. It may be readily controlled by a spray of malathion. (See figure 58.)

Soft scale, *Coccus hesperidum.* This unarmored scale is very thin and flat, oval, and semi-transparent. It infests many different greenhouse plants including ferns. The control is the same as for other scales, a spray of malathion.

Two-spotted spider mite. See Phlox.

Yellow woollybear. Ferns out-of-doors are often eaten by these yellow hairy caterpillars. See Verbena.

Fir

Grey mold blight, *Botrytis cinerea.* In cool, wet seasons the new growth withers, curls, and dies. The greyish mycelium and fruiting bodies appear if the cool, wet weather continues. No spray is known to control this trouble but improving ventilation and avoiding crowded or damp sites will help prevent it.

Twig blight, *Rehmiellopsis balsamea.* Needles of new growth yellow, and twigs die. For control three sprays of Bordeaux applied in the spring about a week apart, beginning when leaf buds are half opened. Pruning and burning affected parts aids control.

Needle cast diseases, *Bifusella faulli, Hypodermella nervata, Lophodermium abietis Rostr.* Needles affected by these fungi turn brown the spring following infection and may persist on the tree. The infective spores are usually discharged about July. Spraying new growth at the beginning of July with Bordeaux, plus a spreader, will help prevent infection of new growth. Pruning and burning badly infected branches may help.

Needle rusts, *Melampsoraceae.* The orange-yellow or white stages of these rusts appear on the upper or lower surfaces of the needles. The alternate hosts include blueberries, willows, and several ferns. Control is usually by removal of alternate host or spraying the new needles with ferbam or Bordeaux, plus a spreader and sticker, as soon as they are full grown.

Yellow witches'-broom, *Melampsorella cerastii.* This stem rust infection causes dwarfing and yellowing of needles beyond the point of attack, and dwarfing and browning of twigs. The alternate hosts are the chickweeds, *Stellaria* sp. and *Cerastium* sp. This fungus may kill saplings if the trunk is infected. Pruning and burning infected parts is helpful but generally not serious enough to warrant any other control.

Balsam twig aphid, *Mindarus abietinus.* This waxy aphid feeds on shoots of fir causing the needles to bend upwards. Severe infestations may kill twigs. Spraying with malathion or lindane should provide control.

Bark beetle, *Pityokteines sparsus.* Vigorous trees may be attacked by the balsam bark beetle, which causes a bleeding of the sap from the trunk of the tree and ultimate

reddening of the needles and dieback of the upper parts of the tree. Pruning and burning the affected parts may help in control. Spraying with DDT might kill many of the beetles.

Spruce budworm. This insect also infests balsam fir which is sometimes more severely injured than spruce. See Spruce.

Spruce mite. This mite infests nearly all kinds of conifers including fir. See Spruce.

Firethorn (Pyracantha)

Scab and fire blight. Pyracantha is susceptible to many of the diseases found on apples, particularly scab and fire blight. The scab causes dark spots on the red berries, and the fire blight kills back leaves and branches. See Apple. For other leaf spots see Hawthorn.

Forget-me-not (Myosotis)

Powdery mildew, *Erysiphe horridula.* Leaves are first covered with white powdery growth, then yellow and die. Sulfur sprays or dusts will keep it in check but are best applied before the fungus appears.

Downy mildew, *Peronospora myosotidis.* Pale spots appear on the upper sides of leaves; a downy growth corresponding on the lower side. Spraying with Bordeaux or zineb in mid-July or as soon as detected will help control it.

Crown rot, *Sclerotium delphinii.* Plants wilt and die. The characteristic cobwebby mycelium may be found at the base of the plant containing seed-like sclerotia. Removal and destruction of infected plants and removal of infested soil is advisable. If replanting is planned, soil sterilization with formaldehyde is necessary.

Aster yellows and curly-top of beet. Viruses. Stunted or distorted growth shows on plants. Not to be confused with 2,4-D injury. Rogue infected plants and keep insects under control. Removal of infected hosts nearby is essential. Examination of nearby weeds may reveal other infected hosts.

Wilt. Hot weather and drouth can wilt and kill forget-me-nots. Consideration of environmental factors as well as laboratory analysis will help determine causal agent. *Rhizoctonia solani* can also cause rotting of the roots with consequent wilting due to lack of water in the plant. If Rhizoctonia is the cause, oxyquinoline sulfate solution 1:4000 (se p. 5) may be applied to infected plants as a soil drench. Repeat applications may be made as needed.

Forsythia

Dieback, *Sclerotinia sclerotiorum.* Flowers are first killed by this fungus which later invades and kills twigs. Black sclerotia may develop on the surface or inside infected twigs. The imperfect phase of this fungus is the grey mold fungus, *Botrytis,* and it is this form that is more commonly found fruiting on dead flowers as grey tufts of mold. This disease is most prevalent in cool, wet weather during flowering time. Pruning and burning infected branches and improving aeration around the bush is helpful.

Foxglove (Digitalis)

Anthracnose, *Colletotrichum fuscum.* Brown to purple brown leaf spots up to one-eighth inch in diameter with indefinite purple margins characterize this trouble. Small black fruiting bodies may be found in the center of the spots. Seedlings may damp off from stem infection. Sprays of ferbam, ziram, or copper should check the disease.

Leaf spot, *Ramularia variabilis.* Leaf spots appear first on lower leaves as brown spots with reddish borders. White cottony mold in the spots on the under side of the leaves is due to the fruiting of the fungus. Leaves wither and die. Copper sprays applied as soon as spots appear may halt the disease, but new growth will have to be kept protected once the trouble has started.

Downy mildew, *Peronospora digitalidis.* Blotches appear on leaves, the underside of which is whitish or dingy lilac. Leaves yellow and die. Sprays of copper or zineb will control the fungus and are applied as soon as the trouble is noted and repeated as necessary.

Stem rot, *Sclerotinia sclerotiorium. Sclerotium rolfsii.* Plants wilt and die. Examination reveals white cottony mycelium growing around the stem at soil level and on the soil. Small seed-like sclerotia may be found caught in the web. Removal and destruction of infected plants is indicated, and infested soil should be replaced by clean soil to at least a depth of 4 inches.

Fuchsia

Greenhouse whitefly. This whitefly often infests fuchsia in the greenhouse. See Tomato.

Mealybug. The common mealybug and probably other species infest fuchsia. See Lantana.

Gaillardia

Powdery mildew, *Erysiphe cichoracearum.* Mealy white appearance of leaves in the latter part of the summer indicates presence of the powdery mildew fungus.

Sulfur sprays or dusts applied at the end of July and thereafter as often as necessary will keep it checked.

Gardenia

Bud drop. Buds discolor and drop before opening. The cause is physiological, due to some adverse environmental factor related to humidity. Moving from one location to another, too much heat or dry air, or waterlogging or dryness at the roots may contribute to this trouble. No cure is known other than to keep constant high humidity and a temperature of 70° F.

Stem canker, *Phomopsis gardenia.* Cankers start as sunken brown areas on the stem, sometimes at or below the ground level. The bark splits exposing the wood and eventually develops corrugated longitudinal ridges. The leaves of infected plants turn yellowish green, then yellow and drop. Bud drop is increased, and plants generally appear sickly and stunted and die when the canker girdles the stem.

The fungus gains entry through wounds made by leaf pruning at the time of taking the cutting. Prevention of wounds during handling and the use of sterilized rooting medium will go far toward preventing this trouble. Badly infected plants should be rogued.

Root knot, *Meloidogyne* **sp.** Swellings or galls produced on the roots prevent uptake of water and nutrients and cause plants to become weak and stunted, often yellow. The malformations on the roots are caused by microscopic eelworms which live in soil, water, decaying organic matter, or in the roots of susceptible plants. Young plants usually do not show the effect of nematode infestation, but older plants show marked symptoms.

Prevention of infestation by using sterilized rooting and potting media is the only known control. Infested plants should be burned, and the soil and pots either completely discarded or sterilized before reuse.

Fuller rose beetle. This weevil sometimes injures gardenia. See Rose.

Greenhouse orthezia. This insect also infests gardenia. See Lantana.

Soft scale. This scale is often found on gardenia. See Fern.

Figure 59. Bacterial leaf spot on geranium.

Geranium (Pelargonium)

Bacterial leaf spot and stem rot, *Xanthomonas pelargoni.* This trouble may be serious in greenhouse or garden geraniums. Bacteria invade the vascular tissue of cuttings or plants causing a variety of symptoms. Leaf spots vary from scattered minute translucent dots to brown papery wedge-shaped areas. Leaves may wilt and drop and branches turn black, collapse, and rot. Some varieties carry the bacteria in the vascular tissue but show no symptoms, although they may carry the disease into the cutting bench. The bacteria are very infectious, and plants may pick up infection by contact, from splashing water, from contaminated soil or cutting knives.

Roguing of diseased plants, sterilization of cutting media and potting soil, with clean cuttings, give best control. Plants that are lightly infected on the leaves only can be kept apart and spaced well. With care in watering, they can be brought through for sale. But they will remain a source of infection for other varieties. Experimental use has been made of Agri-mycin.

Cutting rots, *Rhizoctonia solani. Pythium* sp. and others. Many organisms may rot cuttings. Some organisms, such as the *Fusaria, Thielavia,* and bacteria, may be carried in the cuttings, so that use of healthy mother

plants is essential. Healthy cuttings stuck in sterilized sand usually produce good plants. Reuse of sand is possible but may provide a build-up of rot organisms and be more costly in the end. Sterilized sand should be good for two or three lots but not more with safety.

Thielavia root rot, *Thielaviopsis basicola.* The first sign of infection is usually slow growth, yellowing, and dropping of lower leaves and early and continuous flowering. This fungus lives in the soil and invades roots, working its way up inside the plant. Cutting across stems often reveals discolored vascular bundles. The disease therefore may be transmitted in the cuttings as well as picked up from contaminated soil. It is widespread. Use of clean stock and sterilized rooting and potting media give effective control.

Figure 60. Botrytis on geranium.

Botrytis blossom blight and leaf spot, *Botrytis cinerea.* Petals or entire florets may turn dark and wilt prematurely. If conditions which contribute to the growth of this fungus persist, a grey mold appears on infected tissues. This falls on healthy leaves and infects them. Leaf spots are brown and irregular, usually becoming dry and wrinkled with some surrounding yellow tissue.

The disease is easily controlled by lowering humidity and raising temperatures. This trouble often occurs in late winter or early spring when a sharp drop in temperature at sundown causes moisture to condense on plants. Turning on heat one-half hour before sundown may be combined with cracking the vents to prevent this temperature drop and subsequent infection. Removal of infected plant parts is helpful.

Oedema (dropsy). A physiological trouble. Small watery swellings appear on leaves. Corky ridges develop on the petioles, stems, and even petals. This trouble occurs when overwatering and high humidity accompany cloudy weather, often in late winter. Plants recover when growing conditions are improved by withholding water and providing good ventilation and light.

Crinkle. Virus. Infection shows as irregular or circular chlorotic spots on crinkled or dwarfed younger leaves. Symptoms show only during the spring months and disappear during summer. Although these plants look normal, cuttings taken from them will show virus symptoms the following spring. Roguing and control of insects are the only known control.

Mosaic. Virus. Light and dark green mottling of foliage shows in late winter or early spring, affecting part of or an entire leaf. Leaves and plants are usually small. Symptoms are masked during summer, but cuttings taken from these plants will show the disease when temperatures are right. Control by roguing and insect control.

Aphids. Certain species of aphids like the green peach aphid, the foxglove aphid, *Myzus solani,* and perhaps other species sometimes infest geranium plants. A spray of nicotine sulfate and soap, or malathion, will destroy the aphids.

Corn earworm. This insect injured geranium plants in the late fall. DDT dust should control these worms. See Corn.

Cyclamen mite. This mite occasionally curls the leaves of geranium. See Cyclamen.

Garden slugs. Greenhouses are sometimes infested by garden slugs. These slugs are molluscs with no shell. They feed mostly at night, eating notches in the margins of tender leaves. During the day they hide under rubbish, leaving a slimy trail wherever they crawl. Granular DDT or dieldrin may be dusted over the surface of the ground to kill the snails as they crawl. DDT or dieldrin emulsion sprays may be applied to protect plants.

Greenhouse leaf tier. This insect often injures geranium and other plants in greenhouses. See Cineraria.

Greenhouse whitefly. This insect often infests geranium and other plants under glass. See Cineraria.

Mealybug. Mealybugs often injure geranium and other plants in greenhouses. See Chrysanthemum.

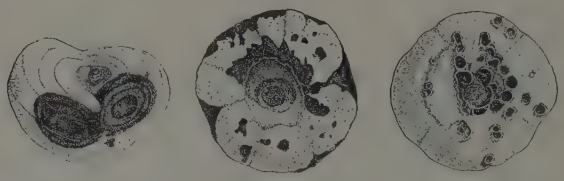

Figure 61. Left to right, Fusarium, dry rot, and scab on gladiolus.

Termites. This insect lives in colonies and the wingless immature insects are white and burrow in wood. The brown adults have wings. The colony usually nests in old stumps, fence posts, or the structural timbers of buildings. Both in the field and greenhouse, these ants have tunneled out the stems of geranium plants.

Treatment of the soil in which the plants are growing with chlordane emulsion, 1 pint in 5 gallons of water, should kill the termites and protect the plants.

Gladiolus

Scab, *Pseudomonas marginata.* The first effect of infection is the appearance of tiny reddish-brown raised dots largely on the basal part of the leaves. These spots enlarge and coalesce to form longitudinal lesions. They produce eventually, if weather conditions are favorable, large brown dried areas on the leaves, followed by a rot of the stem at or just below ground level. Lesions on the corms are at first light-colored watery spots which become darkened with a raised margin, the center of which shows a hard gummy exudate which is shiny and reddish. Corm lesions are shallow and can be shelled out easily. In cool wet seasons or on poorly drained soils the neck rot phase occurs. Otherwise corm and leaf-spotting are the only symptoms of this infection.

Selection of a well-drained soil gives good control of scab. Bichloride of mercury (corrosive sublimate) is used for preplanting dips for gladiolus corms. The corms are soaked in 1 ounce of the powder dissolved in 7½ gallons of water for 2 hours, then rinsed and planted immediately. The same concentration is obtained by dissolving one tablet (8-grain) in 1 pint of water. The chemical is more readily dissolved in a small quantity of hot or warm water and made up to the required quantity with cold water. Since metal containers react with mercury, stone, wooden, or porcelain containers should be used. A half teaspoon of detergent is added for best results. One-third ounce more of corrosive sublimate per 7½ gallons is added after each treatment for three treatments, then it is discarded. Mercury is very poisonous and should be handled with care.

A substitute solution of 1 pound calomel or yellow oxide of mercury in 5 gallons of water (plus detergent) may be used instead. Corms are soaked in this solution one minute, rinsed, and planted immediately. This quantity is sufficient for treating several bushels of corms.

The corrosive sublimate solution as outlined above is a 1:1000 solution and may be used as a soil drench around ornamental plants for control of *Sclerotinia* or *Sclerotium* wilt diseases. Where a 1:2000 solution is called for, the amount of water is doubled or the quantity of bichloride of mercury halved (i.e., ½ ounce of corrosive sublimate in 7½ gallons of water or 1 ounce in 15 gallons makes a 1:2000 solution).

Bacterial leaf blight, *Xanthomonas gummisudans.* Appears only in seasons of excessive rainfall with great destructiveness to foliage, particularly in closely planted stock. Spots at first are small elongated water-soaked marks in the form of squares or rectangles between the veins. If leaves are wet, lesions become long, change to brown or purple and look scorched. The gummy exudate of bacteria is cream colored when dry. Small corm lesions are dark brown.

Corm treatment as outlined under scab will effectively control this trouble, particularly if corms are then planted in a well-drained soil.

Red spot, *Stemphyllium* sp. Small yellow or pale green (at first) spots with a red dot in the center appear on leaves, flower stalks, and bracts. Foliage dies back from tips or along margins until leaf is dead. Entire plants may be killed. Red spot is most destructive just before or just at flowering time: the fungus spots the petals and might be confused with *Botrytis* infection of flowers. Fogs and heavy dews, and warm humid days followed by cool nights favor this disease. Sprays of zineb, applied frequently beginning before flowers open, will help. A spreader must be used if liquid sprays are applied.

Botrytis leaf, stem, and corm rot, *Botrytis gladioli.* Botrytis blight shows on leaves as brown spots with dark margins. Flower spots appear water-soaked and quickly rot. These areas produce masses of spores that spread infection rapidly. A stem rot can develop at any point from spot infection if cool wet conditions persist. The rot works its way downward and is accompanied by the production of black or purplish-black sclerotia if enough moisture is present. Corms show infection in sunken yellowish lesions with darker margins which are hidden by the leaf bases, or as a punky tan decay which works into the corm and is often associated with dark spore masses and sclerotia. The fungus may rot the core, leaving the rest of the corm unaffected, or it may make the corm a dry spongy mass. Rays of decay may extend from the core outward as in the *Fusarium* yellows corm rot, but is not so apt to appear thus. *Botrytis* rot will progress at lower temperatures than other storage rots and is particularly likely to affect improperly cured corms. Artificial heat for curing is advisable if presence of *Botrytis* is suspected.

Botrytis infections require high humidity and temperatures below 70° F. Poorly drained soil and excessive rainfall or irrigation are particularly conducive to this trouble.

Prevention includes discarding infected corms, treating good corms as for scab, and planting in well-drained soil. Deep plowing immediately after lifting from infected fields will destroy much infective plant material.

Yellows, *Fusarium orthoceras Woll.* **var.** *gladioli.* Symptoms show as paling and yellowing of leaves, progressing until entire plant is dead. Dead leaves may fall over or remain upright. Empty spaces in the row at digging time are usually due to this fungus. Corm infection shows as a brown rot at the basal plate extending upward, and if the corm is cut across, brown lines radiate from the core to the nodes. Infected mother corms stick to the daughter corms even though heat cured.

Control is difficult. Some varieties are very susceptible, and the use of resistant varieties is advised. The fungus spreads in storage, so that roguing before storage is important. Husks on infected corms are darker in color and dull in contrast to the sheen of healthy corms. Since the fungus lives a long time in the soil as a saprophyte, planting in new soil is advisable.

Corm treatments as for scab are helpful before planting. Small areas such as home gardens may be fumigated with formaldehyde (see p. 4.) All plants in the area to be treated must be removed first or they will be killed by the formaldehyde. Use of resistant varieties reduces disease losses.

Dry rot, *Sclerotinia gladioli.* Field symptoms greatly resemble yellows, with the dying of leaves and whole plants. However, the rot at the ground level and just above and below is a dry rot. Tiny black sclerotia are to be found in the infected tissue and establish the identity of the organism without question.

Corms may become seriously infected in storage. Infected husks have a dull, lusterless appearance and shatter easily. The corm rot is a dry rot and shows first as small grey spots on corms which may spread until corms are mummies. Sclerotia may also be found in the husks.

Roguing and use of well-drained clean soil is essential for control. The dry rot disease is more serious in wet seasons and in poorly drained soils.

Storage rots. Various fungi. Selection of clean well-ripened corms and curing for 3 weeks at 80° F., with artificial heat if necessary, will help keep down storage rots. Dusting with chloranil or sulfur and DDT combined, with proper storage, are effective procedures. In storage the corms are loosely piled in wire bottom trays at 40° F.

Septoria leaf spot, *Septoria gladioli.* Small brown spots on leaves enlarge and de-

velop dark brown borders. In the center of the spots are many tiny black fruiting bodies of the fungus. The disease may be carried in the corms. Leaf spotting is generally not serious except in wet seasons. Sprays of zineb plus a spreader will control it.

Rhizoctonia neck rot, *Rhizoctonia solani.* Leaves yellow and die down out of season and are rotted at ground level or below. Webs of brown mycelium may be found on and near rotted areas. This trouble appears in cormel plantings.

An oxyquinoline sulfate (see p. 5) soil drench will help to stop the spread of this trouble and will prevent it entirely if applied before it begins. The solution is applied to the soil as the equivalent of a good watering as a 1:4000 solution.

Mosaic (mild). Virus. Light and dark green mottling of leaves early in the season disappears with hot weather. It may be accompanied by fine penciling of color in flowers. The virus is corm-borne and once infected, remains for the life of the corm. The same virus infects beans and other legumes which may act as a source of the trouble. Roguing infected plants, whether glads or other hosts, and control of aphids will keep down infection.

White break mosaic. Virus. Leaves are often but not always streaked or spotted greyish or yellowish green in a manner resembling thrips injury, the result of infection the previous year. Flowers show color breaking, sometimes with thick petals. Florets may be deformed or considerably smaller than normal. Flower color fades quickly, and bud color is lighter on infected plants. Flower breaking may show without symptoms on leaves. Infected corms may be warty and malformed. Continual inspection during flowering and prompt roguing of infected plants is essential. Roguing must be thorough to be effective. Recent investigations show gladiolus to be a reservoir of many undetermined viruses. Isolated plantings and roguing of all weeds in and around fields will be helpful in elimination of many of them.

Cutworms. Various species of cutworms occasionally injure gladiolus. See Tomato.

Gladiolus thrips, *Taeniothrips simplex.* Thrips have caused great injury to gladiolus. The flower buds may be injured so that no good blossoms result. The minute insects hide in the sheaths of the flower stem where it is difficult to reach them with a spray. Burning the old stalks and trash on the field may help in control of this insect.

Corms from an infested field may be treated after drying and cleaning, since thrips live in storage. The corms may be placed in a tight paper bag and 1 ounce of flake naphthalene added for each 100 corms. The bags should be closed tightly for 2 or 3 weeks. Frequent spraying of the plants in the field using DDT or dieldrin emulsion is effective.

Tarnished plant bug. See Celery.

Tulip aphid. This aphid sometimes hibernates on the stored corms, and causes great injury, especially on the new growth. See Tulip.

Two-spotted mites. See Phlox.

Zebra caterpillar. This caterpillar feeds upon many different plants in the garden, including gladiolus. See Cabbage.

Gloxinia

Downy mildew, *Phytophthora cryptogea.* Water-soaked spots appear on leaves and stems. Plant collapses and dies quickly. Corms may show rotted spots of a dark brown color. Plant only healthy corms. Pull and burn all infected plants and corms and sterilize soil before reuse (see p. 4.) Sprays of copper or zineb when symptoms first appear may halt the disease.

Stem or foot rot. Various fungi. Basal leaves and lower stems rot. Microscopic examination is necessary to determine the causal organism. For infection by *Rhizoctonia solani* the oxyquinoline sulfate treatment (see p. 5) may be tried.

Spotted wilt. Virus. This virus is commonly found on tomatoes, peppers, dahlias, and many other plants. Spots appear as concentric rings. Whole leaves may become involved, and plants die. Several species of thrips carry the disease. Disease is reduced by roguing infected plants and isolating plants from possible carriers and by control of thrips by spraying or dusting with DDT.

Foliar nematodes. Water-soaked blotches on leaves become brown and spread through the leaves which disintegrate. Care to avoid splashing water when watering will reduce the trouble.

Goldenglow

Asiatic garden beetle. See Lawns.

Goldenglow aphid, *Macrosiphum rudbeckiae.* A red aphid often infests the tender shoots and may literally cover the topmost portion, sucking the sap. A good remedy is to spray with malathion or nicotine sulfate and soap.

Sawfly, *Macrophya simillima.* The larva of a sawfly sometimes defoliates the plants. It is about three-fourths of an inch in length when full grown, light gray with darker gray median stripe and a row of large black spots on each side about halfway between the median stripe and the spiracles. It coils when resting on the leaves. The adults emerge early in June and there is one brood annually. A spray of DDT or malathion is the remedy.

Slugs and snails. See Lettuce.

Stalk borer. This borer is often found in an occasional stalk of goldenglow. See Dahlia.

Two-spotted mite. See Phlox.

Gooseberry

Blister rust and cluster cup rust. These rusts occur on gooseberry. The same restrictions as for currants apply to gooseberries. See Currant.

Powdery mildew, *Sphaerotheca morsuvae.* This mildew occurs on the fruit and foliage, producing the usual mealy white growth on the surface typical of all powdery mildews. Usually it is not important, but early season sprays of sulfur give control, if needed.

Other diseases. See Currant.

Currant fruit fly. This insect also infests gooseberry. See Currant.

Gooseberry fruit worm, *Zophodia convolutella.* Gooseberry fruit is sometimes infested by greenish larvae, three-fourths of an inch long, with brown head. Infested berries usually color prematurely and may either dry up on the bushes or fall to the ground and decay. The moth has a wing expanse of about an inch, and is grayish in color with darker lines across the forewings and a row of small black spots near the outer margin. The life history of this insect has not been thoroughly worked out, but apparently there is only one annual generation. It passes the winter in the pupa stage under dead leaves and trash on the ground. Little is known about control of this pest. Rotenone dust has been suggested, applied as soon as the berries start to turn red.

Gooseberry spanworm, *Cymatophora ribearia.* This insect occasionally feeds upon gooseberry and currant, and the larvae is about an inch in length when full-grown. It has the habit of a measuring worm and loops when it crawls. It is whitish with yellow stripes and black spots. It pupates in the ground and the moth emerges late in June. The moth has a wing spread of about 1¼ inches and is light buff in color with a row of parallel gray dashes across each wing. The eggs are laid on the bark in July and hatch the following spring. Treatment is seldom needed, but a spray of DDT is effective when the larvae are small.

Imported currantworm. The larvae feed upon gooseberry. See Currant.

Two-spotted mite. See Currant.

Gourds

See Squash

Grape

Black rot, *Guignardia bidwellii.* Black rot is the most common and serious disease of grapes in Connecticut. The fungus attacks the stems, leaves, and fruit, causing the most serious injury on the fruit. The disease shows on the leaves and stems as small, circular brown spots with dark borders. The infected fruit develops a hard, brown rot at first and later the berries blacken and dry into hard, raisin-like mummies which cling to the stem for some time. The fungus winters over on the stem lesions and mummied fruit. Ferbam sprays on the opening shoot buds, immediately before bloom, and 10 to 14 days later, give control for the season.

Downy mildew, *Plasmopara viticola.* This disease appears as a white mold-like growth on the fruit, leaves, and young stems. The fungus grows out on the underside of the leaf where it is often obscured by the leaf hairs. It can be recognized by the reddish areas on the upper side of the leaf. Infected fruit may develop a light brown rot or maintain a nearly normal appearance but fail to ripen. Ferbam or copper sprays, following the schedule for black rot, will control downy mildew.

Powdery mildew, *Uncinula necator.* Powdery mildew appears as a white mealy growth on the upper surfaces of the foliage, reaching its peak in late summer. This is not an important disease but is mentioned because of its slight resemblance to downy mildew, for which it might be mistaken. The schedule for downy mildew, using copper, is reported as giving good control.

2,4-D injury. The use of 2,4-D herbicides on lawns has posed a problem on grapes. Either from drift or by using the same sprayer for spraying the grape vines, many homeowners have injured grapes, which are highly susceptible to 2,4-D compounds. These materials cause a stunting of the leaves, together with an extensive proliferation of the veins and elimination of the lobes, making the leaf look like a palmleaf fan.

Cottony maple scale. This scale is often found on grape although it does not cause serious injury. See Maple.

Eight-spotted forester. The larvae of this insect often feed on grape leaves. See Virginia-creeper.

European fruit lecanium. This scale that infests many different kinds of trees and shrubs often occurs on grape vines. See Peach.

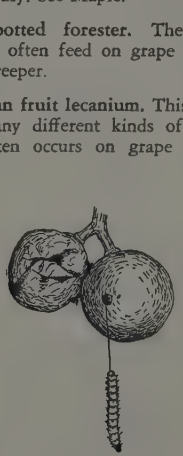

Figure 62. Grape berry moth.

Grape berry moth, *Polychrosis viteana.* The grape berry moth is the cause of most of the wormy grapes. There are three broods each year, and the insect always passes the winter in the cocoon stage on damp and decaying leaves on the ground. The moths emerge the first of June and lay eggs on the stems of the blossom clusters, and the young caterpillars web together and partially devour the buds and blossoms. They continue feeding on the blossoms and newly-set berries, becoming full grown about July 1, when they are about three-eighths of an inch in length, and vary in color from dark green to purple, with light brown head. They then cut peculiar flaps in the leaf and fold them to form a cocoon or case in which to pupate. In 2 weeks the moths emerge, and have a wing spread of about half an inch. In color they are purplish brown with darker markings on the fore-wings. These moths lay eggs on the green berries, in which the young larvae burrow and feed during July and August. Infested berries often show purplish spots and sometimes crack open. A larva may leave one berry and enter a second or third berry, fastening them together with a few silk threads. This second brood of caterpillars does the greatest damage, and the third brood larvae feed during September, sometimes in the ripening fruit. (See figure 62.)

Control measure is DDT applied in three sprays, the first application soon after the fruit sets, the second 10 days later and the third about the last of July. Bagging the clusters in the small garden will protect them from injury.

Grape cane girdler, *Ampeloglypter ater.* The small larvae tunnel in canes, causing death of the terminal portion. The eggs are laid by a small black snout beetle. There is little real damage except unsightly vines. Sprays for other pests usually control girdlers.

Grape flea beetle, *Altica chalybea.* This is a glossy greenish-blue leaf beetle less than one-fifth of an inch in length, which eats the buds of the grapevine just as growth begins. It has caused severe injury in limited areas in the eastern half of the United States. The female beetles lay eggs under the edges of loose bark, and the young grubs feed upon the upper surface of the leaves in June and July, partially skeletonizing them. The old beetles hibernate under loose bark, trash, and wherever they can find protection.

There is a single annual generation. Perhaps the best treatment for the control of this beetle is to keep the vines sprayed with DDT between June 15 and July 15, or after the fruit has set. This will help control the grape berry moth, Japanese beetle, and other leaf-feeding insects.

Grape leafhopper, *Erythroneura comes.* Both nymphs and adult leafhoppers suck sap from the undersides of the leaves, which soon turn brown. There are two broods each year. In late fall the adults seek protection in woodlands, brush, weed, or grass areas, where they pass the winter. The adult is only an eighth of an inch long, and is white, peculiarly marked with yellow and red.

Sprays of DDT or methoxychlor have killed both adults and nymphs.

Grape leaf folder, *Desmia funeralis.* The small larvae fold the leaves, fastening them with silken strands, and feed within. The adult moth is dark brown with two white spots on each wing. Spraying with DDT or methoxychlor in June has controlled this pest.

Grape phylloxera, *Phylloxera vitifoliae.* This insect is an aphid having two forms. One is a yellow wingless form causing nodules on the roots. The other forms galls on the leaves. There may be six annual generations of the root form and from five to seven generations of the gall-making form on the leaves. This insect is extremely destructive to the European varieties derived from *Vitis vinifera,* and such varieties can be grown here only when grafted on the roots of American species of grape.

Grape plume moth, *Pterophorus periscelidactylus.* The larva of this moth webs together the tender terminal leaves and feeds inside the nest. It does not injure the shoot but feeds on the leaves. It is light green with white hairs and reaches a length of about half an inch. It matures late in June and the pupa is fastened to a leaf. In a week there emerges a yellowish brown moth with deeply cleft wings or "featherwings." This insect causes little real injury, though some growers are alarmed over it. Dormant oil sprays will control it.

Grape root worm, *Fidia viticida.* In some portions of the eastern United States the grape rootworm is considered the most destructive insect pest of the grape. The adult is a small grayish-brown leaf beetle which eats peculiar chain-like holes in the leaves in July. The larvae or grubs devour the small root fibers and eat off the bark of the larger roots and main stem beneath the surface of the ground. Badly injured vines have yellow leaves that fall prematurely, the fruit withers and drops, and in severe cases the vines die. The beetle is about one-fourth of an inch in length. The eggs are laid in batches under the loose bark on the old canes. The young grubs drop to the ground, enter through cracks or crevices and make their way to the roots where they feed for the remainder of the season. They live in the soil as larvae through the winter, continue feeding in the spring and late in May or early in June ascend to the upper 2 or 3 inches of soil and make earthen cells in which they pupate. There is one generation each year. Spraying the foliage with lead arsenate or DDT kills the beetles.

Grape scale, *Aspidiotus uvae.* This scale occurs on the old canes, especially under the edges of the loose bark. It is not very injurious. The shells are circular or somewhat elliptical, gray or yellowish brown, with a pale yellow exuvial spot with a whitish nipple at one side of the center. There is a single generation each year; the winter is passed by the nearly matured females, which complete their development in the spring, and in May and June give birth to living young. When control is needed, a dormant spray of oil is suggested.

Figure 63. Grapevine tomato gall.

Grapevine tomato gall, *Lasioptera vitis.* This is a swollen or tumid deformation of the new growth which takes many forms and may involve the leaves, tendrils, blossom buds, and the terminal shoot itself. The eggs are laid in the tissues by a midge or small fly and the galls contain cells in which pinkish maggots or larvae develop. There is one generation each year. (See figure 63.) If necessary, sprays of methoxychlor or DDT, applied as soon as growth starts, should be effective.

Japanese beetle. When abundant this beetle may cause severe injury by feeding upon the tender terminal leaves of grape. Sprays of methoxychlor or DDT early in July protect the foliage.

Light-loving grapevine beetle, *Pachystethus lucicola.* This is a fairly common beetle about one-fourth of an inch in length, usually with light-brown wing-covers without markings. Another form is purplish black

and both forms may be found feeding upon grape, Virginia-creeper, and sometimes beans. There is one generation each year and the winter is passed by the partially-grown larvae in the soil, where they feed upon grass roots. It is only when abundant that any control measures are necessary, and then the foliage may be sprayed with DDT.

Rose chafer, *Macrodactylus subspinosus.* The rose chafer is often a serious pest of grape and sometimes devours the blossom buds, blossoms, and newly-set fruit in addition to riddling the leaves. See Rose.

Sphinx caterpillars. There are several kinds of hornworms or sphinx caterpillars that often feed upon grape leaves. Some of these are the abbot sphinx, *Sphecodina abbotii,* the hog caterpillar, *Ampelophaga myron,* and two less common species, the achemon sphinx, *Pholus achemon,* and the Pandorus sphinx, *Pholus pandorus.* Hand picking is the remedy in common practice. but where the vines are sprayed with DDT or methoxychlor, these caterpillars have been killed.

Spotted grapevine beetle, *Pelidnota punctata.* This is a light-brown glossy beetle marked with black spots. The beetles feed upon grape and if numerous may do some damage.

H

Hawthorn

Fire blight, *Erwinia amylovora.* Leaves on branches suddenly shrivel and turn blackish-brown as though scorched by fire. Discoloration and death of wood follows. The causal bacteria are carried by bees and inoculated into flowers at blossom time. The disease is most severe on pears but occurs also on apples, mountain ash, and Pyracantha.

Sprays of Agri-mycin have given good control on pears and may be tried on hawthorn. One ounce Agri-mycin in 10 gallons of water are sprayed at early bloom, full bloom, and petal fall. Infected wood should be cut out well below damaged part and burned.

Leaf spot, *Fabraea maculata.* Leaf spotting occurs in June. Small angular purple dots are produced by this fungus. Leaves yellow and drop. Three sprays of ferbam or thiram applied 10 days apart starting the middle of June will control it.

Leaf rust, *Gymnosporangium globosum.* The rust spots appear brown or orange on the upper side of the leaves, but from the underside long slender whitish tubes break open to shed orange-brown spores. Infected leaves fall. Damage to hawthorn is slight. The alternate host is the cedar. Control can be obtained by spraying with ferbam or thiram, three times 10 days apart, starting the first of May. Removal of cedars from the vicinity (1 mile radius) will cut down infection.

Stem rust, *Gymnosporangium clavipes.* Leaves, twigs, and fruit are attacked by this fungus. Orange spots are produced on leaves which soon fall. Fruit and twigs may be deformed. Spores that infect the hawthorn are produced on cedars during long spring rains, but infection does not spread from hawthorn to hawthorn. Control as for leaf rust. The fungus is perennial in the cedars so that infected trees remain a threat to hawthorns year after year.

Powdery mildew, *Podosphaera oxycanthae.* This fungus appears as a white mold that covers leaves and new growth much in the manner of apple powdery mildew, often deforming and killing. Control is obtained by spraying or dusting with sulfur as soon as it appears. Affected new growth should be pruned out and burned. If infection has been bad in previous years, sulfur sprays may be applied three times at weekly intervals beginning the first of May.

Aphids, *Aphis pomi, Rhopalosiphum fitchii, Amphorophora crataegi.* Several species of aphids frequently infest hawthorn. The rosy apple aphid, *Anuraphis roseus,* sometimes curls the leaves, and all species secrete honeydew which supports sooty fungus.

Sprays of malathion, lindane, or nicotine sulfate and soap will control these aphids. Several applications have been required to provide complete protection. See Bulletin 588.

Cankerworms. The cankerworm feeds upon hawthorn. See Apple.

Cottony maple scale. See Maple.

Gypsy moth. The caterpillars feed upon the leaves of hawthorn. See Oak.

Hawthorn lace bug, *Corythuoha cydoniae.* This is a small lace bug that lives on the underside of the leaves. Spraying with DDT, lindane, or malathion gives good control of this pest.

Roundheaded apple borer. This insect is also a borer in hawthorn. See Apple.

San Jose scale. See Apple.

Scurfy scale. See Pear.

Thorn limb borer, *Saperda fayi.* The larva of this beetle is a borer in the smaller branches and twigs of hawthorn, where it causes swellings about an inch long with four or five longitudinal scars. Infested twigs break off in the wind. The beetle is half an inch long, brown, with two white crescent-shaped spots near the middle of the wing covers and two smaller circular spots near the apex. The thorax has a white stripe on each side extending upon the base of the wing covers. There is one annual generation and the beetles appear in June. The only control measure to be suggested is to remove and burn the infested twigs.

Two-spotted mite. See Phlox.

Hazel

Aphid, *Macrosiphum corlyi.* Aphids infest the leaves of hazel. If control is neces-

sary, malathion, lindane, or nicotine sulfate and soap should be effective.

Hazel bud gall, *Eriophyes asellanae.* This gall, caused by a mite, is rather common on *Corylus americana.* Usually it involves a terminal bud, but sometimes occurs on a lateral bud. Spraying before the galls form with malathion, Aramite, or Dimite should be helpful in controlling these mites.

Hazelnut weevil, *Balaninus obtusus.* This is one of the smaller nut weevils, having a length of between one-fourth and one-third of an inch. It varies in color from ash-gray to brown, and has darker dorsal markings. The beetles appear in June, and the females deposit eggs in the developing nuts. The infested nuts fall early. There is one annual generation. Spraying with DDT, chlordane, or dieldrin when the weevils appear in June may be helpful if control is required.

Hazel whitefly, *Trialeurodes corlyi.* This whitefly infests the leaves of both *Corylus americana* and *C. rostratus.* It is rarely abundant and control measures probably are unnecessary. Malathion spray may be used.

Hemlock

Tip blight, *Botrytis* sp. New growth curls and dies and may be covered with a gray mold of the fruiting stage of the fungus during prolonged cool wet springs. A change in weather conditions will stop the ravages of this fungus. We know of no fungicide that will give good control of *Botrytis.*

Phomopsis twig blight, *Diaporthe conorum.* Needles turn brown and fall from affected twigs. The wood is dead, and small black fruiting bodies of the causal fungus may be found on the twigs. Another fungus, *Myxasporium abietinus,* may also be found under similar circumstances. These fungi are usually found on trees growing under unfavorable conditions. Pruning and burning infected twigs removes source of future trouble.

Rhizoctonia root rot, *Rhizoctonia solani.* A general unthrifty condition of the tree may be followed by needle discoloration and drop. Needles are often white-tipped, sometimes with brown and white tips. Examination of roots shows lack or rotting of fine roots, and the fungus has even been found invading the bark at the collar of the tree. This trouble is found most often on newly planted trees. Laboratory identification of the fungus is necessary.

Our research has indicated that several applications of oxyquinoline sulfate solution (see p. 5) to the trees have proven unusually successful in bringing them back if they are not too far gone. The progress of the disease in a hedgerow may be halted by this means.

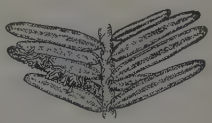

Figure 64. Needle rust on hemlock.

Needle rust, (Hemlock-blueberry). *Pucciniastrum myrtilli.* Long white tubes which discharge orange spores form on the lower side of needles in early summer. Often only a single needle will be infected. Alternate hosts are members of the blueberry family: azaleas, rhododendrons, etc.

Control is best effected by removal of alternate host or spraying the alternate host in mid-July with ferbam or thiram to prevent infection on alternate hosts, thereby breaking the life cycle. This rust is apt to be more serious on members of the blueberry family than on hemlock.

Needle rust, (Hemlock-hydrangea) *Pucciniastrum hydrangeae.* Similar to hemlock-blueberry rust. Control is by removal of alternate host.

Needle rust, (Hemlock-poplar). *Melampsora abietis-canadensis.* Rust pustules form on both upper and lower sides of needles with this fungus. All other needle rusts on hemlock fruit only on the underside of the needles. Infection also occurs on young twigs and cones, which are distorted as the cluster-cups form and burst to discharge orange spores. Control is usually by removal of alternate host, the poplars. Damage is slight to the hemlock. Infected twigs may be pruned and burned.

Cone rust. Needles, shoots, and cones may be affected showing a yellow discoloration followed by raised, waxy, brownish-red projections late in summer. Control is unknown.

Hemlock borer, *Melanophila fulvoguttata.* The larva of this destructive beetle is a borer under the bark of living, injured, and dying hemlock and spruce trees. The adult beetle is about three-eighths of an inch, flattened,

and is dark bronze in color with three small whitish spots on each wing cover. The larva is one of the so-called flat-headed borers. They make sinuous interlacing flattened galleries in the inner bark and sapwood, thus girdling the tree. The beetles are abroad in June and July. Presumably there is one brood each year.

The only known measure of control is to cut the infested trees and to burn the bark in late winter or early spring. Trees kept in vigorous condition by use of fertilizer and water may escape serious infestation. Spraying with DDT when the adults are present might be helpful.

Hemlock looper, *Lambdina fiscellaria.* A one-inch yellow caterpillar sometimes defoliates hemlock. A double row of small black dots along the body of the insect serves as an identification mark. The moth is tan to gray in color. Spraying with DDT or lead arsenate when new growth starts will control the insect.

Hemlock scale, *Aspidiotus* sp. This is a gray circular scale that occasionally infests the leaves and causes them to turn yellow, giving the tree a sickly appearance. Spraying with malathion early in August has controlled this scale. See Bulletin 588.

Hemlock webworm, *Gelechia abietisella.* The larva of this insect webs together a few leaves and feeds upon the leaves inside the web. The larva is less than one-fourth of an inch in length and some individuals are bright green and others are brown though structurally alike. The moth is whitish with pale brown tips and with darker brown cross bands on the costal margin. It has a wing spread of less than half an inch. Evidently there is one brood each season and the eggs are laid in June. The larvae apparently live over winter in the webs in a nearly full-grown state. DDT or malathion spray applied early in the summer may be expected to give satisfactory control.

Pine leaf scale. This scale occasionally infests hemlock. See Pine.

Red-banded leafroller. Green larva with brown head (five-sixteenths of an inch long when mature) skeletonize the leaves, causing them to turn brown and drop in late summer. The winter is passed in the pupa stage in trash under the trees. The moths appear in the spring. Spraying with lead arsenate is the most satisfactory control. See Apple.

Spruce mite. This mite infests nearly all kinds of conifers and may be expected to occur on hemlock. See Spruce.

Strawberry root weevil, *Brachyrhinus ovatus.* This weevil deposits eggs in the soil around young hemlocks during the summer months. The larvae feed on roots until cold weather, when they burrow down in the soil. They resume feeding in the spring. The principal damage is to the roots, although the adult weevils feed on bark and foliage. These adults are about three-eighths of an inch long, and reddish brown to black in color. Treatment of the soil around the plants with DDT, chlordane, or dieldrin has killed the larvae.

Hibiscus

Corn earworm. Although usually a pest of corn, the caterpillars sometimes injure flowering plants, including hibiscus. DDT dust should kill the caterpillars if treatment is required. See Corn.

Japanese beetle. See Rose.

Hickory

Anthracnose, *Gnomonia caryae.* Irregular purplish or reddish-brown spots appear on leaves which may merge to form irregular shaped blotches. Control may be effected by spraying new growth with ziram, zineb or copper when leaves are half-grown and full grown. Ferbam has been reported as unsatisfactory for control of this fungus.

Witches'-broom. *Microstroma juglandis.* Witches'-broom at ends of branches shows most clearly in winter. New leaves in spring are light in color and have the white moldy fruiting phase of the fungus on the underside. The control of this disease has not been worked out, but a dormant spray of lime-sulfur or Bordeaux applied before the buds break in the spring may be tried. Destruction of broomed twigs and fallen leaves is valuable as a supplementary measure.

Canker, *Poria spiculosa.* Cankers form around dead branch stubs. These stubs appear to be nearly healed but brown fungus threads may be found in them. This wood-rotting fungus will eventually spread through

the tree. No control is known. Cleaning and scraping the canker and removal of all discolored wood may help. Wounds should be painted with a good tree paint or Bordeaux paint.

Aphids. Several species of aphids are found on hickory. Three species, *Monellia carye, M. caryella,* and *M. costalis,* are common on the leaves. On the twigs occurs a larger ash-gray aphid *(Longistigma caryae)* with triangular black spots on the thorax of the wingless forms; the winged form has the thorax all black. If control measures are needed, a spray of malathion, lindane, or nicotine sulfate and soap will kill the aphids.

Cigar casebearer, *Coleophora caryaefoliella.* Larvae one-fifth of an inch long with a black head mine the leaves causing them to turn brown and drop prematurely. The insect overwinters in cigar-shaped cases averaging about one-eighth of an inch long. They may be seen on the twigs and branches. Adult brown moths emerge in the spring. Spraying with DDT or lead arsenate as soon as the leaves have developed will control the insect.

Fall webworm. The fall webworm commonly infests hickory trees. See Pear.

Hickory bark beetle, *Scolytus quadrispinosis.* This beetle is the most destructive enemy of hickory trees in Connecticut and breeds under the bark. The female in July makes a vertical tunnel about an inch long in the inner bark and sapwood, with a row of pockets along each side. In each pocket she deposits an egg. The grubs hatching from these eggs commence to tunnel in a direction at right angles to the parent gallery, but the larval galleries, though narrow at first, increase in width as they extend, and those at the ends of the parent gallery are deflected so as not to run into the other galleries. Even a few such brood galleries may girdle the branch. They usually begin in the upper part of the tree. The adult is a small brown or black beetle, one-fifth of an inch long, with abdomen truncated at the apex and bearing four short spines. The beetles emerge in June and July through round holes resembling shot holes and eat at the bases of the leaf stems, causing many leaves to turn brown in July. Some drop and others hang upon the trees. There is one generation annually. This pest does most damage to weak trees. Fertilizing and watering trees may help to avoid infestation.

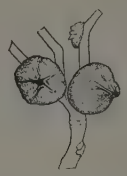

Figure 65. Gall of hickory gall aphid.

Hickory gall aphid, *Phylloxera caryaecaulis.* This aphid forms galls in June on the leaf stems and new shoots. The hollow galls contain the young aphids. In July the aphids reach maturity and leave the galls, which turn black. The galls are globular and cause much distortion to the shoots. Eggs remain over winter in the old galls and in crevices of the bark. A spray of malathion, lindane, or nicotine sulfate and soap made just before the buds swell is a satisfactory control. (See figure 65.)

Hickory horned devil, *Citheronia regalis.* The appearance of the larva suggests the common name of this insect. It may reach a length of more than 5 inches and varies in color from green to reddish brown. There are two large black spots on the second thoracic segment and short black spines on each segment with longer black-tipped ones near the head which are called horns. It is never sufficiently abundant to be considered a pest, but occasionally it feeds on the leaves of hickory and other trees. The adult is called the regal moth and is one of our largest and most beautiful moths with a wing spread of 5 to 5½ inches. The forewings are taupe gray with light red along the veins, with a number of oval buff spots. The rear wings are light red with buff spots. If abundant, this insect can be controlled with DDT sprays.

Hickory leaf galls. There are several insect galls on hickory leaves, most of them being caused by midges or two-winged flies. Some of the more common are the hickory tube gall, *Caromyia tubicola,* the hickory seed gall, *C. caryaecola,* the hickory onion gall, *C. holotricha,* the hickory peach gall, *C. persicoides* and the hickory leaf gall, *C. carye.* These galls are seldom destructive enough to require control. DDT sprays applied to the developing leaves in the spring should help control the adults.

Hickory leaf roller, *Argyrotaenia juglandana.* The larva is yellowish green, about an inch in length, and rolls hickory leaves in a characteristic manner and feeds upon them inside the rolls. The moth is dark brown with darker oblique bands on the forewings. It has not been a serious pest. If necessary, DDT or malathion sprays can be applied in the spring for control.

Hickory tussock moth, *Halisidota caryae.* This insect feeds upon hickory and other tree foliage. The full-grown larva is about 1½ inches in length, covered with white hairs, with a stripe of black hairs along the back, and two narrow pencils of black hairs at each end. The adult moth has a wingspread of about 2 inches, with forewings light brown marked with oval white spots and darker brown veins. The rear wings are light buff. The eggs are laid in patches on the underside of a leaf in July. There is one annual generation and the insect hibernates in gray cocoons fastened to trees, fences, and other objects. Spraying with DDT or malathion gives control. (See figure 66.)

Figure 66. Hickory tussock moth.

Painted hickory borer, *Megacyllene caryae.* The larva of this beetle tunnels under the bark and in the sapwood of hickory. The beetles emerge in May and June and there is one annual generation. The beetle is about three-fourths of an inch in length, blackish with yellow markings. There are three narrow cross-bands on the thorax, a W-shaped mark across the wingcovers near their base, and several other wavy cross-marks. The eggs are laid in crevices or under the edges of the bark and the young larvae tunnel partly in the bark and partly in the wood. The larvae become mature in from 10 to 12 weeks, and pupate in the wood in September and there hibernate until spring.

Thrifty trees are seldom injured by this insect. Cutting and burning infested trees and all slash is the usual measure of control. Choice shade trees could be protected by applying DDT spray to the bark in May and June.

Walnut caterpillar. The walnut caterpillar feeds upon hickory. See Walnut.

Holly

Powdery mildew, *Microsphaera alni.* Mealy appearance of upper surface of leaves marks presence of this fungus. Several sprays of sulfur applied a week apart as soon as noticed should control it.

Tar spot, *Phacidium curtisii.* Black raised spots resembling a spot of tar on leaves indicates infection by this fungus. The disease may be reduced by picking and burning infected leaves, supplemented by spraying with dichlone the first of May and the first of June.

Leaf spots, *Phyllosticta iliciola, Gloeosporium niveum.* Several fungi are responsible for leaf spots on hollies, but they are not common. No spray program has been worked out for these.

Twig canker, *Phomopsis crustosa. Physalospora ilicis.* Brown areas appear on green wood of new growth and eventually enlarge to girdle the twig. Small black fruiting bodies of the fungus may be seen on the dead wood. Pruning and burning infected twigs is valuable.

Purple spot. Mechanical injury to holly leaves causes a purplish discoloration immediately surrounding the injured area. Wind-whipping in winter may drive the leaf points into other leaves. The same effect may be produced by the holly leaf miner.

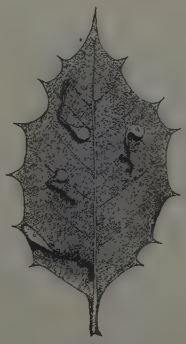

Figure 67. Work of the holly leaf miner.

Holly leaf miner, *Phytomyza ilicis*. The adult is a small, black fly about one-sixteenth of an inch long. It emerges in late May or during June. Eggs are deposited in the underside of the leaves. Larvae make mines which broaden out as the insects develop. There is one brood a year. Spraying with DDT during June will control the adults. Lindane or malathion spray in July controls the larvae. See Bulletin 568.

Hollyhock

Rust, *Puccinia malvacearum*. This is the most common disease on hollyhocks. The fungus spots the leaves, petioles, stems, and green flower parts first with a pin-point brown dot, which enlarges rapidly making a brown raised disk on the under surface of the leaves. On the top of the leaf is an orange spot with a red center. Reddish-brown spores are shed from the pustules. Spores soon change to grey when they germinate. This rust appears to have but one host, hollyhock and its relatives. It overwinters on hollyhock debris and on the older leaves at the base of the plant from which new infections start each spring.

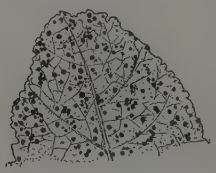

Figure 68. Hollyhock rust.

Control is difficult. Disposing of all dead stalks and leaves, and picking off the first leaves in spring will help reduce infection. Sprays of ferbam or zineb applied at weekly intervals from then on may help. One authority suggests sulfur. Hollyhock varieties may be more or less susceptible. Culling the susceptible varieties and retaining the more resistant ones is partially successful. Common mallow, *Malva rotundifolia* (a weed), is also susceptible and can carry the infection over the winter. Complete elimination of weed hosts is indicated.

Leaf spots, *Cercospora althaeina. Phyllosticta althaeina.* Various fungi cause spotting of leaves other than rust infection. *Cercospora* spots are whitish with a dark margin, the tissue in the center often falling away to give a "shot-hole" appearance. The *Phyllosticta* spots are similar but larger with small black fruiting bodies in the center of the spots or the centers may fall out leaving ragged edges.

Anthracnose, *Colletotrichum althaeae*. This disease is most frequently found on seedlings as black blotches on the leaves, petioles, and stems. Control for anthracnose and leaf spots consists of picking and burning infected leaves. Spraying with Bordeaux or thiram may help prevent spread.

Stem canker, *Sclerotinia sclerotiorum*. Cankers appear at ground level as dark-green watersoaked lesions that rapidly girdle the stem. Centers of cankers turn light brown. The sclerotia are found on the cankers and in the rotted pith of the stems. Roguing and burning of infected plants is helpful. If practical, soil may be sterilized with formaldehyde, chloropicrin, or steam (see p. 4) Or soil may be removed to a depth of 3 to 4 inches and replaced with clean sand.

Imported long-horned weevil. See Pansy.

Japanese beetle. See Rose.

Painted-lady, *Vanessa cardui*. The caterpillar feeds upon the leaves of hollyhock, at first under a web, then on the upper surface of a leaf. Sometimes it webs together two or more leaves and lives inside. It reaches a length of about 1¼ inches. In color it varies from light green to light brown mottled with black, with a light dorsal stripe and with a yellow stripe along each side. It is covered with grayish spines. The butterfly has a wingspread of about 2½ inches and is orange red with black and white markings. This butterfly is double brooded in the northern states. Control is seldom required, but DDT or malathion sprays may be used.

Red-banded leafroller. See Apple.

Stalk borer. The larva of this insect occasionally tunnels in hollyhock. See Dahlia.

Tarnished plant bug. See Peach, plant bugs.

Two-spotted mite. See Phlox.

Honeysuckle (Lonicera)

Crown gall, *Agrobacterium tumefaciens*. The stem is swollen at or above the ground

level on one or more sides with a round gall with a rough or irregular surface. The bacteria causing these galls enter the plants through wounds and stimulate an abnormal proliferation of cells to make the gall. Honeysuckle and euonymus are particularly susceptible. Roguing and planting good uninfected stock in a new location are the only controls one can use.

Leaf curl, *Herpobasidium deformans.* Leaves are deformed, thickened, and curled with whitish bloom. Pruning, destroying infected branches, and spraying full-dormant with lime sulfur or Bordeaux have controlled this disease.

Powdery mildew, *Microsphaera alni var. lonicera.* White mealy covering on leaves without curling and deformity. Sulfur sprayed or dusted as soon as the trouble appears has controlled this trouble.

Canker, *Nectria cinnabarina.* Cankers appear on branches or main stems. Their surface is roughened and contains reddish pustules of the fungus. Removal and destruction of affected parts is indicated.

Crinkle. Late in the summer the leaf surfaces commonly appear rugose and a greyish brown. No known organism causes this trouble, but it may be a heat reaction.

Aphids. At least two species of aphids attack honeysuckle. One, *Rhopalosiphum conii,* feeds on the leaves, and another is a woolly aphid, *Prociphilus xylostei,* attacking both leaves and twigs. If necessary, sprays of malathion, lindane or nicotine sulfate and soap will control these aphids.

European honeysuckle leafroller, *Harpipteryx xylostella.* The larva of this insect is a leaf roller of the Tartarian honeysuckle, and sometimes causes a very ragged appearance of the leaves. It is leaf-green with two chocolate median stripes and a lighter blue-green stripe on each side of the median stripes. It reaches a length of nearly three-fourths of an inch, thickest at the fifth abdominal segment, from which it tapers to a narrow head and tail. The cocoon is white, fastened to a leaf and is sharp-pointed at both ends. The moth is chestnut-brown, with cream-colored rear margin on forewings. Tips of forewings are extended backward and form recurved hooks. Wing spread is about four-fifths of an inch. Spraying with DDT or lead arsenate will prevent defoliation.

Honeysuckle sawflies, *Zaraea inflata* and *Z. americana.* Climbing and bush honeysuckle are sometimes stripped of leaves by the larvae of these large sawflies. The larvae reach a length of about an inch, are dull gray with yellowish dorsal and latero-ventral stripes. There is a row of black spots along the back in the middle of a yellowish stripe. There is one annual generation. The insects winter as pupae in the ground and the adults emerge in April. They are medium-sized sawflies that resemble small bees. Both have brown-clouded forewings; *americana* has a metallic green abdomen, and *inflata* a black abdomen with yellow ring at base and silver pubescence on the rear margin of each segment. DDT, malathion or arsenate of lead sprays applied at monthly intervals during the growing season will protect foliage from these pests.

Snowberry clear-wing. The larvae of this moth feed upon Tartarian honeysuckle. See Snowberry.

Horsechestnut

Leaf blotch, *Guignardia aesculi.* Large reddish-brown blotches on the leaves are surrounded with yellowed tissue. Curling of infected leaves is common, and the fruiting bodies of the fungus appear as black specks in the discolored areas.

Raking and burning fallen leaves will cut down on the source of infective spores. Spraying new growth with ferbam, thiram, or Bordeaux is effective when applied as the buds break, and when leaves are half and full grown.

Anthracnose, *Glomerella cingulata.* Leaves and new growth appear blighted, and wood is killed back for a short distance. Pustules formed on dead leaves and wood produce pink masses of spores. Control is by spraying as for leaf blotch coupled with pruning and burning of infected twigs.

Powdery mildew, *Uncinula flexuosa.* White powdery appearance of leaves indicates the presence of this fungus. Sulfur sprays or dusts applied as soon as the disease is noted will control it, but generally it is not serious enough to require spraying.

Canker, *Nectria cinnabarina.* Roughened cankers appear on branches bearing reddish-brown fruiting bodies. Pruning and burning of affected branches, cutting well back of infected area is advisable.

Japanese beetle. See Rose.

Scurfy scale. See Pear.

Figure 69. Caterpillar of white-marked tussock moth.

White-marked tussock moth, *Hemerocampa leucostigma.* This insect has two generations each year, and spends the winter in frothy white egg-masses on the trees. The eggs hatch in late May and the caterpillars mature about July 1 and make their gray cocoons on the trees. Two weeks later the moths emerge and the females lay their egg-masses, usually on the old cocoons. The second brood larvae hatch in July and mature in August. The caterpillars reach a length of about 1½ inches. They are striped lengthwise with brown and yellow, and are hairy, with four upright white tufts on the front half, two long pencils of black hairs near the head, and a similar one on the tail. There is a bright red spot just back of the head. The female is ash-gray without wings. The male has prominent feathered antennae with wings ash-gray with darker gray markings. It has a wingspread of about 1¼ inches. (See figure 69.) Spraying with DDT in late May and June will control this pest.

Horseradish

White rust, *Albugo candida.* This fungus disease shows as white, roundish irregular blisters on leaves. These blisters eventually break open, and are seen to be filled with the white, powdery spores of the fungus. The fungus also attacks certain weeds, such as shepherd's-purse. The disease is not important enough to require regular control measures.

Leaf spot, *Alternaria brassicae.* The usual leaf spot on horseradish in Connecticut appears as fairly large, dark target-spots. Special control measures usually are not required.

Horseradish flea beetle, *Phyllotreta armoraciae.* This flea beetle is about one-eighth of an inch in length, black with yellowish wing-covers, except for a narrow black outer margin and a broader inner margin, the latter appearing as a central longitudinal stripe, broadest in the middle. It feeds upon horseradish and watercress. The females lay eggs on the petioles of the young leaves in May, and the larvae burrow in the petioles, often killing some of the leaves. The insects hibernate as a pupae in the ground and there is only one generation each year. Control is seldom necessary, but should be accomplished by using DDT.

Hyacinth

Yellow rot, *Xanthomonas hyacinthi.* Water-soaked appearance of flowers and yellow longitudinal stripes in the leaves mark this trouble. The yellow stripes eventually turn brown and if cut across masses of yellow bacteria ooze out. Bulbs show rotted pockets.

Since the bacteria are spread by splashing water or rain and wind from plants grown from diseased bulbs or the soil around these plants, care in watering and planting only disease-free bulbs are indicated. It is claimed that the bacteria do not live over winter in the soil, and roguing appears to be the only control known. Experimental use of Agrimycin may be helpful.

Soft rot, *Erwinia carotovora.* Plants fail to flower or buds open irregularly, and the plant can easily be pulled out of the ground. Rotted parts have a foul odor. Bulb is usually rotted in part or entirely.

Proper curing and storing of bulbs is important. Trouble is encouraged by repeated freezing and thawing and also by too much heat or water while forcing, or by heating of bulbs during storage or while in transit.

Planting clean bulbs, storage in a well-ventilated room, combined with avoiding excessive watering or excessively high temperatures while forcing are best protective measures.

Grey mold blight, *Botrytis* sp. Flowers shrivel suddenly and are covered with grey mold. Leaves discolor at outer ends and become rotted and covered with the mold. This fungus thrives in cool wet seasons. A change in weather will stop its progress. Destruction of infected plant parts is indicated.

Ring disease. Nematodes. Leaves are deformed with yellow flecks or blotches on them which can be felt as small pustules if the leaf is drawn through the fingers. When leaves are wet, nematodes pass to the soil and into the bulb and below ground parts. In-

fected bulb scales are brown and appear as brown rings when the bulb is cut across. These nematodes are spread in rain or irrigation water on tools, shoes, and the like.

Removal of infected bulbs and plants and burning in addition to sterilization of infested soil with chloropicrin (see p. 4) will keep them controlled. Hot-water treatment of dormant bulbs at 110° F. for three hours gives effective control. Clean bulbs should be planted in sterilized soil.

Bulb fly. This fly also injures hyacinth. See Narcissus.

Bulb mite. The bulb mite injures hyacinth. See Narcissus.

Hydrangea

Chlorosis. Leaves yellow between the veins or sometimes the entire leaf is yellowed. It is thought to be due to too much lime in the soil. It may also be correlated with very high levels of nitrates and calcium. Soil analysis is indicated.

Leaf spot, *Phyllosticta hydrangeae.* Brown spots on leaves contain little black pimples in the center. Flowers may be affected in severe cases. Sprays of ferbam, thiram, or Bordeaux have been recommended for control.

Powdery mildew, *Erysiphe polygoni.* Mildew appears as a grey mold on undersides of leaves with a brownish tinge in patches. The upper side of the leaf remains green or becomes a purplish brown. Buds and new growth may be attacked and deformed. Dusts or sprays of sulfur applied to the underside of the leaves will control spread of mildew. Old infected leaves should be pruned and burned.

Stem nematodes. The stems of greenhouse hydrangeas are swollen and split. Leaves drop off. Cutting potted plants back severely and repotting often removes the infested parts of the plant. Washing off all old soil from roots and putting plants into clean soil also reduces the chances of reinfestation.

Rose chafer. The rose chafer sometimes feeds upon hydrangea. See Rose.

Tarnished plant bug. This insect is often found on hydrangea. See Peach.

Impatiens

Anthracnose, *Gloeosporium impatientis.* Leaf blotches appear, and terminals are blighted. Spraying with ferbam, thiram, or Bordeaux will control it.

Damping-off, *Rhizoctonia* sp. Plant wilts and may fall over showing a rot of the stem at ground level. Our research has shown that if trouble has not progressed too far, oxyquinoline sulfate (see p. 5) poured on the soil around the plant is an effective control. In severe infections more than one application may be necessary.

Tobacco mosaic. Virus. This highly infectious virus is easily transmitted by hands or tools. Merely brushing against a good plant after touching an infected one will suffice to inoculate the healthy plant. Mottled light and dark green color appears in leaves, and flower production is inhibited. This virus also infects tomatoes, eggplant, pepper, tobacco, ground cherries, Jimson weed, nightshade, matrimony vine, and bittersweet.

Disease may be reduced by roguing and burning all infected plants. Washing hands with soap and water to remove virus before handling good plants is a good protective measure. This mosaic may also be carried in smoking or chewing tobacco. Since the disease can also be transmitted by insects, control of flea beetles, aphids, tomato worms, and leafhoppers is important.

Root knot nematodes. Plants are unthrifty, small and sickly. Roots contain oval or elongated galls. Roguing and burning infested plants and fumigation of infested soil (see p. 4) are best means of control.

Iris

Soft rot, *Erwinia carotovora.* This rot attacks leaf bases and rhizomes and is easily identified by means of its foul odor. The bacteria gain entrance by means of wounds, usually made by iris borers. Infection first shows as water-soaked edges to the borer hole in the leaf, progressing as a water-soaked streak down the leaf. Once in the rhizomes, rot progresses rapidly.

When rhizomes are divided in August, the pieces may be cleaned or all rotted portions and dipped in bichloride of mercury 1:1000 (1 tablet in 1 pint water) before replanting in clean soil. Setting the rhizomes shallow is helpful since this permits the sun to get to part of the rhizome. Crowded or shaded situations are conducive to development of soft rot. Well-drained soil is better for iris than heavy or poorly drained soils.

Prevention of borer infestation is indicated. Cleaning up all plant debris on which the borer eggs overwinter in the fall or very early spring will cut down materially on borers. Spraying or dusting leaves with DDT is suggested in spring, (a sticker-spreader is necessary for sprays).

Leaf spot, *Didymellina macrospora.* This disease is usually found on bulbous iris. Tiny brown spots with yellow borders are spattered over the tops of the leaves. These enlarge rapidly after the flowers have gone, and the leaves may be killed back severely. Successive infections, which destroy the leaves, weaken bulbs and rhizomes often killing them.

The fungus overwinters on old leaves, and good sanitation is sufficient control. In very wet seasons infection may get serious and sprays of zineb or ferbam can be applied once a week starting in mid-June.

Leaf blight, *Phytomonas tardicrescens.* This leaf trouble starts as small water-soaked spots in the leaves. These may enlarge longitudinally or may dry out and show as yellowish brown spots. Microscopic examination reveals numerous bacteria in the tissues. The water-soaked characteristic may reappear with wet weather. Rhizomes are not involved as in soft rot. Cleaning up plant debris in the fall should control this trouble as it does leaf spot.

Mosaic. Light and dark green mottling of leaves, early flowering, and color breaking in flowers, combined with a general stunted appearance of plants occurs most often on bulbous iris. Bud sheaths may be marked with bluish-green or yellow streaks. It occurs also on rhizomatous iris but the symptoms are not so noticeable. Aphids carry the disease. Rogue infected plants and control aphids.

Crown rot, *Sclerotium delphinii.* This trouble appears usually in overcrowded beds. Leaves and flower stalks die back from infec-

Figure 70. Leaf spot of iris (left), and sclerotia of crown rot organism (right).

tions at the base where white cottony mycelium containing mustard-seed size sclerotia may be found. The sclerotia vary in color from cream to reddish-brown. This fungus is pathogenic on many other flowers (delphinium, aconite, columbine) and may be spread by scattering the sclerotia during cultivation. Removal of infected plants with infested soil generally stops progress of the disease. Thinning plants and admitting light and air to the area is suggested.

Nematodes. When bulbous iris fail to grow or growth appears distorted, bulbs should be examined for brown patches or longitudinal stripes indicative of nematode infestation. Diseased plants can be rogued and the soil sterilized before reuse.

Botrytis rhizome rot, *Botrytis convoluta.* Plants fail to grow in the spring, and rhizomes are rotted with a dry hard rot having no foul odor. The grey mold fruiting stage is generally present, and shiny black convolute sclerotia may be found on or in rotted tissues.

Roguing and burning infected plant parts destroys sources of infection. Removal of infested soil or its sterilization (see p. 4) with steam or formaldehyde eliminates the fungus from the area.

Rust, *Puccinia iridis.* Rusty pustules appear on leaves of susceptible varieties. Alternate host is a marsh reed. German iris is immune. Roguing and burning of infected plants breaks the continuity of the rust's life cycle. Use of resistant varieties such as Wedgewood is helpful.

Aphids. Aphids occasionally infest iris but cause little injury. If they are abundant, a spray of malathion or nicotine sulfate will kill them.

Iris borer, *Macronoctua onusta.* This insect has a pinkish larva with brown head that tunnels in the rootstock of German iris, injuring or destroying many plants. It reaches a length of about 1½ inches in late fall and pupates in the ground. The adult moth emerges in October. The moth has a wing spread of about 2 inches, and is brown with black markings on the fore-wings. The females lay eggs on the iris leaves. These eggs hatch in the spring and the young larvae tunnel in the stems and soon find their way into the rootstocks. There is one brood each year. (See figure 71.)

In early spring the leaves may be gathered and burned to destroy the eggs. Spraying with DDT or malathion once a week during April and May might kill the young larvae before they bore into the plants.

Figure 71. Iris borer.

Iris weevil, *Mononychus vulpeculus.* This insect breeds in the seed pods of blueflag iris *(Iris versicolor)* and may be found in European, Japanese, and native cultivated iris. It creates many small holes in the seed pods. Eggs are deposited in the iris ovary. The larvae feed on the seeds. The adult weevil is black and one-fifth inch long. It emerges when the pods open. One brood occurs each year from overwintering adults. Removal and destruction of all flower heads as soon as the blossoms wither should reduce the infestation. Spraying with DDT, malathion or arsenate of lead will kill adults.

Lesser bulb fly, *Eumerus tuberculatus.* The maggots of this insect occur in the rhizome or root of iris or in weakened retarded plants. They are not responsible for the injury as they generally feed on the injured or decaying tissue, some of which may have been caused by the iris borer. The maggots are a dirty white color and about one-third inch in length. The adult resembles a house fly in appearance.

Control may be expected when infested rhizomes are cut out and destroyed. Spraying the plants with DDT or malathion during the growing season may be helpful in controlling the adult flies.

Iris thrips, *Bregmatothrips iridis.* Small, milky-white larvae feed on the inner surface of leaf sheaths and on the young leaves of many varieties of iris causing a rusty or soot-like blackening. The adult is dark brown and glistening and overwinters in the crowns of the iris. Spraying with DDT, malathion or dieldrin will give satisfactory control.

Slugs and snails. See Lettuce.

Two-spotted mite. See Phlox.

Ivy, English
See also **Boston Ivy**

Winter injury. Edges of leaves are browned and papery, and whole stems may be killed back. English ivy often shows injury from low temperature. Baltic variety is less susceptible and is suggested for use in exposed locations.

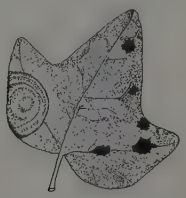

Figure 72. English ivy. Left, Phyllosticta; right, bacterial leaf spot.

Bacterial leaf spot, *Xanthomonas hederae.* Irregular water-soaked spots have yellow or sometimes translucent borders. It usually appears on lower or inside leaves of densely crowded foliage or on greenhouse ivy. Infections on the petioles produce black lesions which crack longitudinally. Stem infections may result in yellowing and reduction of growth. Improving ventilation usually corrects the trouble. Picking and destroying infected leaves and careful watering is suggested in the greenhouse.

Leaf spot, *Phyllosticta concentrica.* Large tan spots on ivy leaves often show concentric rings of fruiting bodies of the fungus. Twigs may also be killed back. Removal and destruction of infected parts may be combined with sprays of ferbam, thiram, or Bordeaux plus a spreader.

Dodder. Many strands of orange "string" with no apparent roots and not readily detached are wound around stems of ivy. Small clusters of white flowers produce many seeds for another year's crop. When seeds germinate the dodder climbs up the nearest plant, sends little penetrating knobs called haustoria into the tissue of the host to obtain its nutrients. The dodder roots are dropped as soon as this attachment is made, and it becomes a truly parasitic plant. Removal and burning of dodder is indicated if possible. Otherwise roguing affected plants with the attached dodder is necessary.

Ivy aphid, *Aphis hederae.* This aphid has been found several times on English ivy in Connecticut. It may be controlled by spraying with malathion or nicotine sulfate and soap.

Imported long-horned weevil. See Pansy.

Mealybugs. Mealybugs often infest English ivy in houses and greenhouses. See Lantana.

Soft brown scale. This scale infests English ivy and many other kinds of plants. See Fern.

White or oleander scale. This circular scale infests the leaves and stems of various greenhouse plants including English ivy. See Oleander.

J

Juniper (Redcedar)

Nursery blight, *Phomopsis juniperovera.* This disease is fairly common in nurseries, attacking twigs and small branches of young stock. The leaves and twigs turn a light brown color and die. Small black dots on discolored areas may be the fruiting bodies of the fungus. Branches or small trees may be killed by the fungus. Leaders are often attacked. Reports indicate some control with New Improved Ceresan, with a spreader, used as a spray and applied to new growth when half and full grown.

Figure 73. Apple gall on cedar.

Cedar-apple rust, *Gymnosporangium juniperi-virginiana.* Cedars are infected during the summer by the rust spores produced on apple leaves, but the greenish-brown cedar "apples" or galls do not appear until the following June and do not fruit until the second spring after infection. In wet spring weather the galls swell and extrude bright orange gelatinous horns on which spores are produced that infect the apple. After spore production the gall dies. Control on cedars may be attempted by spraying the cedars three times in July a week apart with ferbam, or thiram, plus with a spreader, beginning the first week of the month.

Cedar-hawthorn rust, *Gymnosporangium globosum.* Galls produced on cedar are similar to cedar-apple rust galls but are round, mahogany red, and perennial. The spore horns produced in a rainy spring are shorter and flatter than those of cedar-apple rust

Figure 74. Cedar-hawthorn rust.

galls. Control consists of cutting out galls and spraying trees as for cedar-apple rust.

Birds nest rust, *Gymnosporangium nidus-avis.* Infection in the stems causes a witches'-broom effect on the cedars and may appear as long spindle-shaped swellings which kill the growth beyond the infection. The only known control is the eradication of alternate hosts in the vicinity (apple, quince, mountain ash, hawthorn, and serviceberry).

Cedar-quince stem rusts, *Gymnosporangium germinale* and *G. clavariaeforme.* Infection of cedars shows as fusiform swellings of branches but fruiting in *G. germinale* appears as a coffee-colored jelly and in *G. clavariaeforme* as bright orange projections during long spring rains. Both fungi cause leaf, stem, and fruit infections on quinces. *G. germinale* also infects hawthorn, shad-

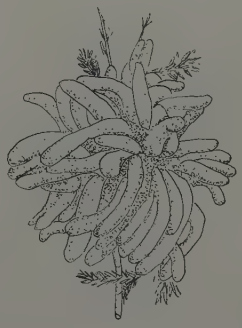

Figure 75. Cedar-apple gall—late stage.

bush, and apple similarly. Eradication of alternate host or spraying cedars in July with ferbam or thiram, with a spreader, will prevent infection by spores on pomaceous hosts.

Fomes root rot, *Fomes annosus.* The fungus attacks and rots the roots and wood of many trees, particularly cedars which are in poor condition for some reason. The discolored wood has a pinkish or violet tinge and is a diagnostic characteristic. No control is known.

Aphids. Redcedar trees may be injured in May and June by infestations of aphids. Sprays of malathion or nicotine and soap should control them.

Bagworm, *Thyridopteryx ephemeraeformis.* Spindle-shaped bags hanging from the trees indicate infestation. The larvae carry the bags around with them as they feed. Serious infestation may result in partial or complete defoliation of a tree. The adult is a moth. Winter is passed in the egg stage. There is one generation a year. Spraying or dusting with DDT or arsenate of lead when the young worms first appear usually during May has controlled this pest.

Juniper scale, *Diaspis carueli.* This is a circular white scale that infests the leaves of redcedar and other species of juniper. Spraying with a miscible oil, one part in 20 parts of water in early spring has proved an effective remedy. Malathion spray applied the first week in July has killed the young crawlers. See Bulletin 588.

Juniper webworm, *Dichomeris marginella.* Low juniper plants in particular are infested by the juniper webworm which webs together the leaves and twigs. The larva is a light brown caterpillar, half an inch or less in length, which feeds upon the leaves in the webs. The moths appear early in June and have a wing spread of five-eighths of an inch, with forewings dark brown, and front and rear margins white. Spraying with DDT, malathion or lead arsenate has given good results.

Redcedar bark beetle, *Phloeosinus dentatus.* This is a light brown or black beetle, one-sixteenth of an inch in length, which excavates broad galleries under the bark, especially in sickly and dying trees. If trees are kept in vigorous condition, there will be little injury by this insect. Severely injured trees should be removed and burned.

Spruce mite. The spruce mite injures juniper. See Spruce.

K

Kale

Turnip aphid. This aphid infests kale. See Turnip.

Some of the insects that injure cabbage also feed upon kale. See Cabbage.

Kerria

Leaf and twig blight, *Coccomyces kerriae.* Leaves and stems may be infected. On the leaves infection shows as reddish spots with dark borders and, if numerous, leaves yellow and fall. Stem cankers are produced as discolored more or less extended darkened areas which may crack open to reveal the black fruiting bodies beneath. The perfect stage of the fungus is produced on fallen leaves that have wintered over on the ground.

Raking and burning of fallen leaves and pruning out any infected twigs are designed to reduce the inoculum. Spraying with ferbam, thiram, or Bordeaux when leaves are half grown and again when full grown will give good control.

Kohlrabi

In general, the insects that injure cabbage also feed upon kohlrabi. See Cabbage.

Lantana

Greenhouse orthezia, *Orthezia insignis.* This curious insect sucks the sap and is common in greenhouses, especially on lantana and coleus. It is sometimes called the lantana bug. It is not fixed upon the plant but crawls about like a mealybug and there is usually considerable wax secretion. (See figure 76.) This insect can be controlled by spraying with a strong mixture of nicotine sulfate and soap, or with malathion.

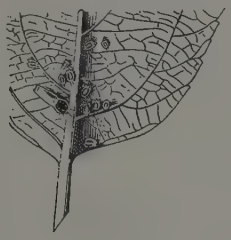

Figure 76. Greenhouse orthezia.

Mealybug, *Pseudococcus citri.* Mealybugs commonly infest a large number of greenhouse plants, especially begonia, coleus, croton, chrysanthemum, fern, geranium, heliotrope, lantana, oleander, and palms. Like the greenhouse orthezia, mealybugs are scales without armor, which crawl around upon the plants and do not become fixed like most scales. The long-tailed species resembles the other except that the long wax filaments suggest its name. Mealybugs have the habit of congregating in the leaf axils, along the veins and in the leaf-sheaths. (See figure 77.) Spraying several times at weekly intervals with malathion has given good control.

Figure 77. Mealybug.

Larch

Branch and trunk canker, *Dasyscypha willkommi.* Infection appears as a depressed area in the bark, often exuding resin at the edges and accompanied by considerable swelling of the branch or trunk (of a small tree) on the opposite side. White cups with orange linings open and close with wet and dry weather and are fruiting bodies of the fungus. Infection can kill small trees and branches of large ones. Often it merely weakens branches so that ice or wind cause them to break easily. The European, American, and golden larch are susceptible, but Japanese larch is relatively resistant. Cutting out and burning of cankered material or use of the Japanese larch is indicated.

Frost injury. New young leaves of larch can be killed by frost, but new growth or secondary buds often replace them. Low temperatures can cause cankers or death of young trees by killing the cambium in stems of less than 2 inches. Examination of wood discloses gummosis, displacement of rays, and abnormal growth where tracheids failed to form in affected areas.

Needle cast, *Hypodermella laricis.* Needles turn brown in spring or early summer and remain on the tree overwinter, which is contrary to the normal pattern of this species. Trees at a distance look scorched. Infected needles bear long black fruiting bodies and eventually fall. This disease may be serious in nurseries. Spraying the new growth as soon as it appears with lime sulfur at intervals of 2 weeks apart until August has proven a useful control measure.

Needle rusts. Two rust fungi may appear as orange pustules on larch needles but are not too important. Alternate hosts are poplars and willows. They are generally not serious enough to warrant control measures.

Larch casebearer, *Coleophora laricella.* The larva of this minute insect is a miner in the leaves. It reaches a length of about one-

fifth of an inch and is dark reddish brown with a black head. The adult is a small ash-gray moth having a wing expanse of three-eighths of an inch and bearing long fringe on the margins of the wings. The moths emerge late in May or early in June and lay eggs on the leaves. The young larva bores its way into the leaf and usually first tunnels out the distal half, packing its excrement into the burrow in the mined leaf. By September the entire leaf has been mined and it cuts off the distal half, cleans out the basal portion, and uses it as a winter case. Later it fastens the case to a twig where it remains through the winter. In spring the larvae dislodge their cases and go to the buds and feed upon the new leaves. When they are fully grown in May they pupate on the branches. From 2 to 3 weeks later the moths emerge. There is only one annual generation.

Spraying with DDT or malathion when the leaves are developing in the spring and again about June 1 may be helpful in controlling the larvae and moths. A dormant spray of lime sulfur before growth commences in spring kills the hibernating caterpillars.

Larch sawfly, *Pristophora erichsonii.* Larch leaves are often eaten by the larvae of this insect, which are dull gray or olive green above, pale green beneath, and nearly three-fourths of an inch in length when fully grown. There is probably one annual brood, and the larvae winter in their cocoons on the surface of the ground under the trees, and pupate the following spring. The adults emerge in May and the females cut into the new shoots to lay their eggs. The young larvae feed upon the leaves, at first cutting notches in the sides. The leaves soon wither and turn brown. Later they devour the entire leaf, and when abundant strip the trees. The adults are black sawflies, the female being nearly half an inch in length and the male smaller. A spray of lead arsenate or DDT will prevent defoliation.

Larch woolly aphid, *Adelges strobilobius.* This woolly aphid is present on larch foliage in June. Its life history is complicated, certain generations occurring on larch and others forming galls on spruce. An immature form hibernates on spruce and a different immature form winters in larch. Choice larch shade trees when infested may be sprayed with nicotine sulfate and soap or malathion in May after the eggs have hatched.

Larkspur

Cyclamen mite. See Cyclamen.

Stalk borer. See Dahlia.

Lawns

Brown patch, *Rhizoctonia solani.* Brown patch is a common turf disease found in lawns and golf greens. Typically it causes irregular spots of varying size which are first a light yellow-green, later turning to a medium brown as the grass dies. The dead grass stays erect and does not mat down. The fungus attacks the roots, killing first the fine feeding roots and later the entire root system. In periods of wet weather or where lawns are watered frequently the fungus may grow up on the lower stems and leaves. Heavy fertilizing and constant watering accelerate the disease. Soil applications of oxyquinoline sulfate will control brown patch (See p. 5). Brown patch attacks all grasses with equal severity.

Lawn rot, *Helminthosporium* **sp.** This fungus attacks the stems and leaves of the plant causing a soft rot of the tissue. This rotting gives a matted appearance of the affected areas unlike Brown Patch. Newly seeded grass is more likely to be affected than older established turf. On new seedings diseased areas have the appearance of having been soaked with gasoline. The causal fungus requires plenty of moisture and warm temperatures, hence is destructive only during periods of warm, wet weather or when the grass is watered frequently at night during summer weather. Watering infrequently in the forenoon will help to prevent an outbreak of lawn rot. Our work on this disease would indicate that spraying with thiram will help to control the disease after it starts, although during prolonged wet spells this material will not give complete control. Lawn rot is more common and destructive on bent grasses.

Copper spot, *Gloeocercospora sorghi.* As the name indicates this disease is characterized by small, light copper-colored spots in the turf. The color is produced by masses of the fungus on the stems and leaves which can be seen easily with the naked eye. The fungus confines itself to the lower leaves and stems so that the spots are not readily seen except immediately after mowing. This disease rarely causes serious injury and control measures are usually unnecessary. If control is necessary, cadmium or phenyl mercuri sprays have proved effective. Most common on bent grasses.

Snow mold, *Fusarium niveum.* The fungus causing this disease attacks the grass during the winter, either under snow cover or during cold winter rains. The injury shows in the spring as irregular spots of nearly white, dead grass. The disease makes no further progress with the coming of warm weather. Snow mold is a disease of the stems and leaves and usually the grass will recover during warm spring weather. Late fall fertilizing, causing the grass to go into the winter in a succulent condition, seems to be conducive to attacks of this fungus. No control measures are suggested as the disease is of minor importance in Connecticut.

Dollar spot, *Sclerotinia homoeocarpa.* This disease is characterized by small circular brown spots which later bleach to nearly white. The spots may remain separate or coalesce into larger irregular areas. This trouble is infrequently seen on lawns but is more commonly seen on golf greens.

Moss. The appearance of moss in a lawn is not necessarily an indication of acid soil. Its presence is most likely to indicate plenty of moisture and a lack of phosphorus and potash in the soil. Soil improvement followed by reseeding can be expected to get rid of the moss.

Algae. This green, slimy growth is often found in damp shady places in the lawn. This growth is a mass of minute green plants called algae. It may be eliminated temporarily by spraying with 1 teaspoon of copper sulfate in 8 gallons of water. As with moss, soil improvement and reseeding is the permanent remedy.

Mushrooms. Mushrooms, commonly called toadstools, often appear in lawns during rainy spells in the summer. Mushrooms are the above-ground growth of certain fungi which grow on decaying vegetable matter in the soil. In lawns this organic matter frequently consists of buried stumps or tree roots. Mushrooms are chiefly a nuisance as they do no harm to the grass and are best removed by raking or sweeping. No material will kill the fungus without injury to the grass.

Slime molds. There are two species of slime molds that commonly appear in lawns during warm, damp weather. One of these molds appears as a bluish-gray, sooty growth on the grass, the other as large masses of an unpleasant dirty-yellow growth. Neither of these organisms do any harm to the grass. They may be swept off with a broom and if one feels that something else should be done the spots may be dusted with sulfur.

Miscellaneous injuries. Sunburn and drought injury are very similar in appearance but may occur independently. Sunburn sometimes occurs during very hot weather following cool, cloudy weather. Different species of grass sunburn differently and this may cause spots in the lawn resembling brown patch. Drought causes the same brown discoloration of sunburn but over larger areas, first in the open sunny areas and later under trees if the drought is prolonged. Watering before it appears will forestall drought injury but unless one is equipped to put on several inches of water at a time, watering is of doubtful value after the grass has once turned brown. Neither sunburn or drought will permanently injure grass and it will recover as soon as fall rains and cooler weather arrive.

Chemical fertilizers applied on wet grass may cause serious burning. Female dogs can cause burned areas on the lawn; eventually these dead spots are surrounded by a ring of heavy green growth of grass. Rugs, rubber mats, and metal dishes put on the grass in the hot sun will surely leave their mark on the grass.

Along the shore, salt spray or flooding with high tides causes serious injury to lawns. The injury from spray is temporary, but if the area is flooded for several hours the damage is likely to be permanent. If the flooding is of short duration, flushing with fresh water immediately afterwards will minimize the injury. There is no chemical that will get rid of the salt in the soil quickly although an application of gypsum at the rate of 100 pounds per 1000 square feet may be helpful. Reseeding should be delayed until rains have had a chance to wash out the salt. It will take at least 2 inches of heavy rain to do this.

Ants. There are several species of ants that commonly injure lawns. Spraying or dusting the lawn with chlordane, DDT, or dieldrin has killed all species of ants. See Circular 188.

Asiatic garden beetle, *Autoserica castanea.* The grubs of this imported insect also feed upon the roots of grass and are responsible for considerable injury to lawns. The life history is similar to that of the Oriental beetle, but adults are much more active in flight and are attracted to lights. They are more injurious as adults and feed at night on many kinds of plants, especially aster, barberry, bean, cherry, chrysanthemum, currant, dahlia, geranium, catalpa, and seedling conifers. During the day the beetles hide in the soil around the plants are seldom seen unless one knows where to find them. The beetle is about three-fourths of an inch in length, dull cinnamon brown, with wing-covers longitudinally and finely striated. (See figure 78.)

Spraying the food plants with DDT and treating the lawns with the poison described under Oriental beetle will afford an effective measure of control.

Figure 78. Asiatic garden beetle.

Chinch bug, *Blissus hirtus.* Dead and brown patches on lawns, although more commonly caused by fungi, are occasionally caused by great numbers of this insect. It is only about one-seventh of an inch long, but though small is conspicuous because it is black and white. It is said to be single-brooded in New England, and is seldom noticed except in connection with dead patches on lawns where the bugs have injured the grass by sucking the juices. Spraying or dusting infested lawns with chlordane, dieldrin, or DDT controls this pest. See Circular 168.

Corn root webworm. Lawn grass is sometimes injured by this webworm, which feeds in tube-like cases. See Corn.

Fall armyworm, *Laphygma frugiperda.* Occasionally lawns are infested by hundreds of brown-striped caterpillars that soon devour every green blade of grass. There are at least two broods here. The insect hibernates as a pupa in the soil. The eggs are laid upon the grass leaves; they soon hatch and the larvae feed upon the grass, reaching maturity in about a month. They are then about 1½ inches long and striped lengthwise with narrow yellow and brown stripes. They pupate in the soil. The first brood of moths emerge in May and June, the second in July and early August, and the third in September. They have a wing spread of about 1¼ inches, with forewings grayish brown, and rear wings pearly white with narrow brownish margins. This insect also feeds upon several different kinds of vegetables. Infested areas on lawns may be sprayed with DDT, chlordane or dieldrin.

Japanese beetle, *Popillia japonica.* The larvae of the Japanese beetle are pests of lawn grass in most areas of the State. Eggs are laid in the grass during July. The larvae feed on grass roots until cold weather, when they burrow down in the ground to hibernate. Feeding is resumed in the spring.

The Japanese beetle, Asiatic garden beetle and Oriental beetle all cause the same type of damage to lawns. If the infestation is heavy, spots of the lawn may be killed in August or September. When tufts of grass are pulled from these areas, it is easy to see that the roots have been cut just below the surface of the ground. Treatment of lawns as described under Oriental beetle below will control Japanese beetles.

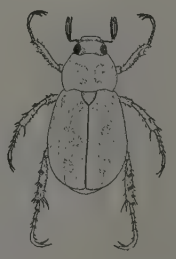

Figure 79. Oriental beetle.

Oriental beetle, *Anomala orientalis.* The larvae, or grubs, feed on grass roots just beneath the surface of the ground. The adults emerge in late June and July, and the females lay eggs in the soil, at a depth of about 6 inches. These eggs hatch in from 3 to 4 weeks and the young grubs ascend and feed upon the grass roots near the surface. In late October and November they descend to a depth of a foot to hibernate. In April they ascend to the surface and resume feeding until the first of June when they go down to a depth of about 6 inches to pupate. They pass through a prepupal period of about 6 days, then pupate, and 2 weeks later the adults emerge. There is one generation each year, although a few individuals do not transform with the others, but require 2 years for their development. The beetle is about three-eighths of an inch in length and varies greatly in color and markings. Some have light brown wing-covers without markings and a small proportion are uniformly purplish black. Many of them have black patterns on the wing-covers and fall between these two extremes. Most of them have yellowish margins on the thorax with solid black in center, but some have wider margins with the central black area divided lengthwise to form two smaller black areas. Apparently the beetles do not fly very much or very far nor feed very extensively, but are often found in roses and hollyhock blossoms and in the turf. (See figure 79.)

To protect lawns from injury by the grubs, chlordane, dieldrin, DDT, or lead arsenate may be applied. Granular forms of chlordane and dieldrin are available and may be substituted for sprays or dusts. Treatment made in summer or fall is less likely to kill birds feeding on earthworms. One application lasts for several years. See Circular 190.

Lettuce

Drop rot, *Sclerotinia sclerotiorum.* Drop rot causes the lower leaves to fall off. Eventually the stem rots through, and the whole head falls over in a slimy rot. The white moldy growth of the fungus may be seen on the rotted head. Eventually the rotted mass may show the hard, black kernels which carry the fungus over in the soil from one year to the next. The disease is favored by heavy, wet soils. To avoid the disease plant in hilled-up rows, in light, well-drained soils. Use a 3-year crop rotation. The fungus which causes lettuce drop rot also attacks other crops such as beans. Beets and onions are safe to use in rotation with lettuce.

Figure 80. Lettuce drop rot.

Bottom rot, *Rhizoctonia solani.* This disease also rots the lower leaves of the plant, but does not destroy the stem. The head will not fall over if infected with bottom rot. As the fungus which causes this disease is also favored by wet, heavy soils, control measures are the same as for drop rot.

Bacterial soft rot, *Erwinia carotovora.* The first symptoms of this disease is a rotting of the edges of the lower leaves. Finally the inner leaves of the head dissolve in a slimy rot. The bacteria which cause this disease live in the soil and are splashed up on the leaves by rain. To avoid bacterial soft-rot, plant in hilled-up rows, on well-drained soil. Use a 3-year crop rotation.

Tipburn. As the name indicates, this disease shows as a scorch of the leaf edges. The disease is not caused by a microbe, but is an injury caused by high temperatures and humid weather. Tipburn usually appears at the time the summer crop matures. Lettuce varieties resistant to tipburn are available on the market.

Yellows. Lettuce plants with yellows are stunted, do not form heads, have white hearts, and a lopsided appearance. The disease is caused by the virus which causes carrot yellows and aster yellows. It is carried from plant to plant by leafhoppers. To slow down spread of the disease, control leafhoppers, keep down weeds around the field, and do not plant lettuce near carrots or asters.

Big-vein. Plants infected with big-vein have open, erect leaves, and very prominent, large clear veins. They are usually not stunted. The symptoms are most pronounced during cool weather. With warm weather, the

symptoms may disappear, and the infected lettuce may proceed to form a normal head. Symptoms are less severe on well-drained soil.

The disease is caused by a soil-borne virus which can survive in lettuce-free soil for at least 8 years. Infested soil may be freed of the virus by steam, formaldehyde, or chloropicrin. The virus is not seed-carried. It helps to plant on well-drained soil, and to seed rather than set out plants. Transplanting injures the roots and makes infection easier.

Recent experiments at this Station indicate that watering flats of lettuce with a solution of zinc sulfate helps protect the treated lettuce seedlings against big-vein in the field. The solution was made up by dissolving 1½ ounces of zinc sulfate in 50 gallons of water. This is the same as 1 teaspoonful of zinc sulfate per 6½ gallons of water. The zinc sulfate solution was watered on the flats of seedlings twice a week for the 3 weeks before the lettuce was set out in the field. This made six applications in all.

Mosaic. Plants with mosaic are severely stunted, and show a leaf mottle. This disease is carried by a seed-carried virus. Plant seed which is free of the disease.

Aphids. Several species of aphids may occur on lettuce, some on the leaves and occasionally on the root. Control aphids, if necessary, by using malathion.

Cutworms. Cutworms sometimes eat off young plants. See Tomato.

Garden slugs. The leaves of lettuce and other garden plants may be eaten by slugs. Slugs are not insects, but mollusks closely related to snails. They have no shells and leave a slimy trail wherever they crawl. These slugs, which are grayish, slimy, legless, soft bodied forms, vary in length from one-half inch to several inches. They hide during the day and feed at night, notching the margins or cutting holes through the tender leaves. They can best be controlled by broadcasting a metaldehyde bait about the plants in the evening. Dieldrin also may be used for control.

Leafhoppers. Small, light brownish-gray leafhoppers may feed on lettuce. They appear to be more severe on late lettuce and are capable of spreading a virus disease, called yellows, from infected weeds to the crop. They can be controlled by early applications of DDT or methoxychlor.

Tarnished plant bug, *Lygus oblineata.* This general feeder may occasionally infest lettuce but can be controlled by the same materials used against the leafhopper.

White grubs. Like wireworms, these insects attack the roots of many crops, particularly in sod land. See Potato.

Wireworms. These general feeders may also attack the roots of lettuce. See Tobacco.

Lilac

Bacterial blight, *Pseudomonas syringae.* Blighting of new shoots is black in color, starting as spots on leaves and branches which rapidly involve the entire shoot. Bacteria may be found in abundance in diseased tissues, including the wood. Pruning and destroying affected shoots serve to eliminate infection from a plant. Agri-mycin sprays may be tried on an experimental basis if prolonged wet season develops. To prevent this blight, two sprays as the new growth unfolds should suffice.

Phytophthora blight, *Phytophthora cactorum.* This blight is very similar to the bacterial blight except that the final color is brown rather than black. Entire suckers or shoots may be killed back to the ground. Disease may be reduced by pruning and destroying affected shoots. Sprays of Bordeaux or zineb may stop infection or give some protection if applied when leaves first appear.

Powdery mildew, *Microsphaera alni.* White mealy appearance of leaves in late summer indicates powdery mildew infection. It is unsightly but does no harm to the bush. Sulfur sprays or dusts applied in mid-July and several times thereafter at 10-day intervals should prevent it.

Graft blight. Non-infectious. Leaves show what looks like a nutritional trouble. Areas between veins become light green or yellow, and margins turn brown or are flecked with necrotic spots. Leaves are smaller, and growth is slower.

This blight occurs when lilac scions are grafted onto privet stock. After a time an incompatibility between stock and scion shows up. If the lilac can make some of its own roots, the trouble may be overcome in time.

Grey mold, *Botrytis cinerea.* In prolonged rainy seasons flowers and some shoots may be blighted with the grey mold fungus. Flowers appear to fade very suddenly, and

leaves shrivel. The grey mold fruiting stage is usually found on affected parts. A change in weather will clear up the trouble.

Lilac borer, *Podosesia syringae.* The larva is a borer in the stems of lilac and privet. It is white or yellowish with dark brown head. The moths emerge late in May and the females lay eggs in patches on roughened places in the bark. The larvae tunnel in the solid wood and sometimes in the pith for a distance of 8 to 10 inches. They also cut across the grain so that the branch breaks over. The larva pupates in the burrow after cutting a passageway to the bark. On emergence, the adult leaves the pupa case protruding from the burrow. There is one brood each year. The moth is a wasp-like clearwing, with wing spread of from 1 to 1½ inches.

A DDT spray applied to the trunk and larger limbs late in May will be helpful in killing the moths before eggs are laid, or in killing the larvae before they enter the bark.

Lilac leaf miner, *Gracilaria syringella.* The larva of this little moth begin their existence as miners on the leaves of lilac and privet, and when partly grown leave the mines, roll the leaf, and feed within the roll. The adult is a tiny ash-gray moth with narrow wings. Spraying with lindane or malathion when mines start should give satisfactory control.

Oystershell scale. This scale often infests lilac. Spraying with malathion about June 15 has killed the young crawlers. See Bulletin 578. See also Apple.

San Jose scale. This scale frequently infests lilac. See Apple.

Lily (Easter or Garden)

Tipburn. Lily leaf tips appear scorched, first turning yellow, then brown. When these symptoms appear, bulbs and roots should be examined. If sound, faulty nutrition is responsible. If discolored roots or areas in the bulbs are present, see Root rot or Bulb or basal rot.

Growing lilies in soils with a high calcium level prevents tipburn. The difficulty may be corrected by applying 2 ounces of hydrated lime or calcium nitrate per pot, followed by watering.

Root rot, *Rhizoctonia* sp. Plants are generally unthrifty with few flowers and may show tipburning of leaves. Buds may blast. Bulbs may be yellowed with rotted areas on scales or brown roots. This fungus is carried in bulbs and in soil. Laboratory examination will permit an accurate diagnosis.

If *Rhizoctonia* is the cause of the trouble, several applications of oxyquinoline sulfate solution (see p. 5) will keep the rot from progressing and enable new roots to grow. Planting clean bulbs in sterilized soil has proven a useful preventive measure.

Bulb or basal rot. Several organisms or bulb mites may be involved. If growth has started, symptoms resemble tipburn and root rot. In *Fusarium* basal rot, failure to grow is due to rotting of the basal plate, scales, and roots.

Roguing growing plants and bulbs is necessary since no cure is known. However, soil sterilization combined with preplanting treatments with thiram (seed-treating form) plus naphthalene acetic acid (2 parts per million) has given fair experimental control of *Fusarium* basal rot. See Narcissus, bulb mite.

Grey mold, *Botrytis elliptica.* Oval or circular spots, reddish-brown at first, develop pale centers and purplish margins. These spots may run together and rot the entire leaf, progressing into the stem and causing the stalk to fall over. If the spots dry out, they turn brown or grey. Buds or flowers may turn brown and rot, often showing the grey mold of the fruiting stage. This disease shows up and spreads rapidly under cool humid conditions, especially if plants are crowded. Thinning plants, removing and destroying infected plant parts, and improving ventilation will help. Raising the temperature and a drier atmosphere will stop its progress.

Mosaic. Virus. Leaves are mottled light and dark green. Plants are more or less dwarfed, and leaves shorter than normal. Affected leaves may be twisted. Few flowers are produced, and buds may be deformed or fail to open. The disease is carried in the bulbs and transmitted from plant to plant by aphids, especially where plants are crowded and heavily infested.

Roguing and destruction of infected growing plants and bulbs serves to eliminate the disease from the greenhouse, but it may be

spread in storage by aphids feeding on infected plants and moving to healthy stock. The disease is also spread when lilies are propagated by bulb scales. However, the virus is not carried in the seed.

Necrotic fleck. Virus. Yellow flecks appear on leaves and change to grey or brown and elongate parallel to the veins. The surface is depressed but unbroken. Plants are dwarfed and have curled leaves. Flowers are small with brown streaks by the time they are fully open. Since this disease is spread by aphids, roguing infected plants and insect control are necessary.

Yellow flat. Virus. Plants are yellowish with downward curled leaves and are definitely stunted. Few flowers if any are produced. Feeding by one species of aphid can cause similar symptoms, but plant growth is normal after aphids have been controlled. Roguing and destruction of affected plants is indicated. Some authorities believe infected bulbs can be discarded because they can be recognized by their small size, being flat, compact and inclined to split.

Bulb mite. This mite injures lily. See Narcissus.

Lily aphids, *Macrosiphum lilii* and *Myzus circumflexus.* Two common aphids occur on the undersides of the leaves of various species of lily. Should they become abundant, the plants may be sprayed with nicotine sulfate, malathion, or lindane.

Mealy flata, *Ormenis septentrionalis.* This is one of the largest of the so-called lantern flies, which are sucking bugs. The eggs are laid in slits in the bark of twigs and covered with masses of a white wax secretion. This insect is found on a great variety of herbaceous plants and shrubs. There is one annual generation and the adults are present in August and September. Although control measures are usually not necessary, the insect may be checked by spraying with nicotine sulfate and soap or malathion.

Stalk borer. This borer is occasionally found in lily. See Dahlia.

Lily-of-the-valley

Botrytis flower-and-crown rot, *Botrytis* sp. Flowers and stems are rotted and covered with a greyish mold. This occurs generally in overcrowded damp situations in prolonged cool wet weather. Thinning plants and improving aeration will stop this trouble, as will a change in the weather.

Leaf spot, *Ascochyta majalis.* Brown spots with purplish borders appear on leaves, petioles, and flower stalks, especially in late summer and fall. Picking and destroying infected leaves in the fall prevents overwintering of the fungus.

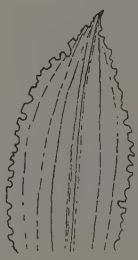

Figure 81. Lily-of-the-valley injured by weevils.

Lily-of-the-valley weevil, *Hormorus undulatus.* The leaves of lily-of-the-valley are often curiously notched by this weevil which eats into the leaf margins. (See figure 81.) Control is seldom needed, but DDT, malathion, or lindane sprays will kill the weevils.

Linden (Basswood)

Anthracnose, *Gnomonia tiliae.* Blotching and browning of leaves from margins inward along the veins is followed by leaf drop. Cankers may be formed on petioles and young wood. To control, spray when buds break, leaves are half grown, and again when full grown with ferbam, thiram, or Bordeaux.

Black mold, *Fumago vagans.* This fungus looks like a deposit of soot on the leaves. The fungus is not parasitic on the leaf but grows on honeydew left there by aphids or scale insects. Control of insects suffices.

Leaf spot, *Cercospora microsora.* Circular brown spots with a dark border appear on leaves. When heavily infected, leaves will drop. Control as for anthracnose.

Powdery mildew, *Uncinula clintonii.* Leaves develop a white mealy appearance. Sulfur sprays or dusts will keep it in check if control seems necessary.

Aphids. The linden aphid, *(Myzocallis tiliae)* and doubtless other species, is found on the leaves of linden, sometimes in abundance. A good remedy is to spray with nicotine sulfate and soap, malathion, or lindane.

Fall webworms. See Pear.

Japanese beetle. See Rose.

Leaf beetle, *Calligrapha scalaris.* White larvae with yellow heads chew holes in the leaves. The adult beetle is oval, yellow with green spots on the wings, and a little over one-fourth inch long. Yellow eggs are laid on the underside of the leaves in early summer. The adults overwinter in the soil under the trees. Spraying the foliage with DDT when the larvae appear in late June and early July controls the pest.

Linden borer, *Saperda vestita.* Small-sized linden trees are often injured near the base by the larva of this insect. It eats out quite a large cavity, decay follows, and the tree soon breaks over. The larva is white and reaches a length of about an inch. It usually burrows near the ground, sometimes going into the roots below the surface. There is usually a vertical gallery next to the bark and a cavity toward the center of the tree. The adult is a long-horned beetle about three-fourths of an inch in length, black, and covered with a dense appressed pubescence that is light olive-green in color. Usually four small black spots are present just below the center of the wing-covers. The beetles emerge late in summer and feed somewhat on the leaves and tender shoots before laying eggs in the bark.

Thorough spraying of the bark with DDT several times in late summer and fall should be helpful.

Mulberry whitefly. The larvae or nymphs of this insect are often abundant on the undersides of the leaves of linden. See Mulberry.

Oystershell scale. See Lilac and Apple.

White-marked tussock moth. This insect occasionally defoliates large numbers of linden trees in cities. See Horsechestnut.

Liquidambar (Sweetgum)

Bleeding necrosis, *Dothiorella berengeriana.* Brown depressed areas appear in the bark accompanied by profuse bleeding. Wood beneath cankers is brown and dead. A tree can be killed in a very short time. No control known other than pruning well back of affected area or roguing diseased trees.

Locust

Canker, *Thyronectria austro-americana.* Infrequently this canker appears on small branches causing a dieback or wilt of branch tips. Cankers at first are small depressed areas which may enlarge to girdle the branch and usually are covered with a gummy exudate. Wood above and below canker shows reddish-brown streaks. Pruning and burning infected branches is advisable.

Aphids. The dwarf flowering locust or rose acacia is sometimes infested by aphids. A spray of malathion or nicotine sulfate and soap will kill them.

Carpenterworm, *Prionoxystus robiniae.* Large galleries are often made in the trunks and larger branches of locust, ash, oak and maple by the carpenterworm, and large unsightly scars are evident wherever this insect occurs. Fortunately, this insect is seldom sufficiently abundant to cause severe injury. The moths emerge in June and July, and the females seem to prefer the vicinity of wounds for depositing eggs. The young larvae at first feed upon the inner bark, then burrow in the wood, chiefly excavating longitudinal galleries. The mature larva is about 2½ inches in length, pink or flesh-colored, with brown head, thoracic and anal shields. The adult moth has a wing spread of about 3 inches and is gray with brown and black markings. It is believed that the life cycle of this insect extends over 3 years.

Removal and destruction of infested branches helps reduce damage. All wounds may be dressed and painted. Injection of carbon disulfide into individual burrows will kill the worms.

Locust borer, *Megacyllene robiniae.* This is a beetle that closely resembles the painted hickory borer (See Hickory), but the adults appear in late summer instead of spring. It is very destructive to the black locust and has ruined many plantings. The eggs laid in the crevices of the bark in September soon hatch and the young larvae tunnel and hibernate in the outer bark, going into the wood the following spring and excavating the characteristic galleries. Evidence of infestation is sawdust falling down on the bark of the trunk and wet spots around the holes where the sawdust was ejected. Later ugly scars show where the wounds have partially healed. There is one annual generation, and the beetles are very abundant on goldenrod blossoms in September. In general, trees are not greatly injured after reaching a trunk

diameter of about 6 inches.

Control measures have not been used generally for this pest. Thorough spraying of the bark with DDT in August should help.

Figure 82. Work of the locust borer.

Locust leaf miner, *Chalepus dorsalis.* This small beetle, less than one-fourth of an inch long, feeds upon the leaves, and the larva is a miner in the leaves of locust. It is orange-red with a median black line along the back. It lays eggs in late May or early June on the underside of the leaves, in clusters of three to five. The larvae hatching from these eggs work their way into the leaf through the same entrance and live in a common blotch mine which may involve half the leaf, then they go to other leaves and make separate mines. The larval life lasts about 3 weeks, pupation takes place in the mine, and the beetles emerge a week or 10 days later and hibernate. There is one brood each year.

Thorough spraying of the fully-developed foliage in early June, using DDT, malathion, or lindane should kill the beetles.

Locust treehopper, *Vanduzea arquata.* This treehopper is often very abundant on locust and it is possible to collect several hundred specimens from one tree. All are sucking the sap, and there are probably three or four broods a year in Connecticut. The adult is a small brown beechnut-shaped insect less than one-fourth of an inch in length and chocolate brown in color. If control is necessary, spraying with DDT or malathion will be helpful.

Locust twig borer, *Ecdytolopha insiticiana.* The larva of this insect tunnels in the small twigs of black locust, causing irregular swellings from 1 to 3 inches long. The borer emerges from the twig through a small exit hole usually between two thorns. The adult is a brown moth with wing spread of three-fourths of an inch. The forewings are chocolate brown crossed near the apex by two light gray bands forming a triangle. The infested shoots may be cut and burned in August before adults emerge. Spraying with DDT after emergence should prevent reinfestation.

Silver-spotted skipper, *Proteides clarus.* This is one of the largest of the skipper butterflies, and the larvae feed upon the leaves of locust, especially the rose acacia. Each caterpillar fastens together with silk threads several leaflets making a case in which it lives and feeds. The caterpillar is leaf-green with brown head. The butterfly is brown with yellow and white quadrangular spots on the forewings. Both front and rear wings are sharp-pointed. An application of DDT will prevent defoliation.

Lupine

Powdery mildew, *Microsphaera* sp. and *Erysiphe polygoni.* White mealy appearance of leaves indicates that one of these fungi is present. Sulfur sprays or dusts give good control. Afternoon applications are preferred because the fungus sporulates at that time.

Damping-off or crown rot, *Rhizoctonia solani* or *Pythium* sp. Rotting of stems or crowns of plants or rotting of fine roots causes plant to wilt and die. This condition is encouraged by crowding or high nutritional levels. Applications of oxyquinoline sulfate (see p. 5) several times as a soil drench may be tried. Effect of this chemical on lupines has not been determined as yet, so that this treatment should be used in an experimental way on a small plot.

Aphids. The leaves of lupines are frequently infested with aphids, *Macrosiphum albifrons.* Spraying with malathion or nicotine sulfate and soap will kill them.

Garden millipeds, *Julus hortensis.* These arthropods resemble wireworms. They are from one-half to two inches long and brown in color. The body is cylindrical and there are many legs. These animals usually feed on decaying organic matter. They may attack living plants. Spraying or dusting with chlordane or dieldrin will control millipeds.

M

Magnolia

Leaf spot, *Phyllosticta cookei.* Greyish spots with indefinite margins indicate infection by this fungus. Several other leaf-spotting fungi are reported on magnolias: one, a *Glomerella,* makes dark brown or black spots with a yellow border. In general leaf spots may be controlled by three sprays of ferbam, thiram, or Bordeaux applied when the buds break, when leaves are half grown, and again when full grown.

Magnolia scale, *Neolecanium cornuparvum.* This is a brown soft scale that infests the lower branches of certain species of magnolia. Some entomologists consider it identical with the tulip tree scale, but as a rule the female scales are more elongated and smaller. There is one annual generation and the young appear in August, settle on the branches and hibernate as oval dark brown nymphs covered with a bluish waxy bloom. It can be controlled by a dormant spray of lime sulfur or miscible oil in the spring. Spraying with malathion or DDT about April 15 should kill the overwintering young scales. See Circular 201.

Mangel

Spinach leaf miner. See Spinach.

Maple

Anthracnose, *Gloeosporium apocryptum.* This disease is widespread on maples, particularly Norway and sugar maples. Large irregular areas on sugar maple leaves turn reddish-brown, usually involving one or more lobes of the leaves. On Norways a purplish discoloration runs along the veins. On both, the fungus fruits abundantly in little pale pink masses. Petioles may also be attacked. From a distance infected trees look scorched.

Control is indicated where infection is heavy or if the looks of the tree are important and may be obtained each season with three sprays of ferbam, thiram, or Bordeaux applied when leaves are half grown, when full grown, and again 2 weeks later.

Purple eye, *Phyllosticta minima.* Small greyish-tan spots with purple borders are scattered over the leaves. Tiny black dots in the spots are fruiting bodies of the fungus. Control is as for anthracnose.

Tar spot, *Rhytisma acerinum.* This fungus produces raised black spots that look like blobs of tar on the leaves. Silver maples are very susceptible, but it is unsightly rather than serious. Raking and burning fallen leaves is sufficient for control.

Leaf scorch. Maple leaves are subject to sunburning, especially if hot sunny days follow a prolonged period of cloudy weather in spring. Sunburning resembles anthracnose infection and can be differentiated only by laboratory examination. Sunburning usually occurs on the south or southwest side of a tree, especially on those in exposed locations.

Figure 83. Anthracnose on sugar maple (left), on Norway maple (center), and leaf spot (right).

Early infection of maple wilt in a large tree, or a girdling root, may resemble this trouble.

Girdling roots. Norway and sugar maples may produce roots that grow around the tree instead of away from the trunk in the normal manner. As girth increases, the girdling root strangles the tree, causing leaves on one side to scorch, or small leaves sparsely arranged on twigs, and a dying back of branches. Growth is slow, and the whole tree dies. A flat side on the trunk usually indicates a girdling root is below ground. When the root can be found early enough and cut off at the point where it begins to curve. the tree can recover.

Bacterial leaf spot, *Phytomonas aceris.* Small water-soaked spots become yellow, then black, causing defoliation. Experimental sprays of Agri-mycin may be tried when leaves are half grown and again when full grown.

Wilt, *Verticillium albo-atrum.* Foliage on one branch or one side of the tree wilts, and sapwood shows intermittent green or green-black streaks. Some trees die quickly but others linger. The infection may originate either from the tips of branches or from the roots.

Where infection is peripheral, immediate pruning well back of any discoloration in the wood and painting wounds with a good tree paint may check the disease. If the discoloration extends into the trunk, little can be done to save the tree. Susceptible species used as replacements, such as elm, catalpa, or ailanthus, are apt to contract the disease. Oxyquinoline sulfate, placed as a dry powder in holes bored in the trunk of affected trees and then corked up, has proven an effective control in some cases.

Bleeding canker, *Phytophthora cactorum.* A wet spot appears anywhere on the trunk from which sap oozes that on drying resembles blood: hence the name. Cankers on young trees are long, with indefinite margins, but hardly show in the rough bark of older trees. Leaves above the canker wilt, and branches may die. In chronic cases leaves are small, and dieback appears slowly. The tree may die in from 2 to 4 years. Sapwood beneath cankers contains reddish-brown radial streaks with olive-green margins. No control is known, but injecting helione orange dye into the tree seems to prevent wilting and branch dieback. Sometimes untreated trees recover.

Nectria canker, *Nectria cinnabarina.* Cankers start as depressed areas which quickly girdle branches on which cinnamon-colored fruiting pustules are abundant. Leaves, beyond the point of attack, wilt but remain attached to the tree. Eventually the branch dies. Either the Nectria or wilt fungus or a girdling root may be suspected in cases where one branch of a tree turns red in the fall before the rest of the tree. If discovered in time, cankers can be scraped out and painted to prevent further infection. Pruning well back of cankered area and burning infected wood removes a source of new infection.

Shoestring root rot, *Armillaria mellea.* This fungus penetrates the bark of collar and roots at and below the ground level, eventually killing the tree. The crown may have small leaves and produce little or no new growth. This is followed by dieback of branches. The growth increment of the trunk is slight.

The fungus may be recognized by the rhizomorphs produced in the ground or along or under the bark of the roots or collar. Rhizomorphs look like black shoestrings but are actually cables of fungus threads protected by a rubbery black cover. White mycelial fans on the inside of loose bark are also indicative of infection by this fungus. The toadstools or fruiting bodies are honey-colored with a pebbly top and appear in clumps near the base of the tree in wet fall weather.

Attack by this fungus is apt to occur on older trees, particularly where environmental conditions have changed, such as cutting surrounding trees or a change in drainage. Control has been obtained by injecting the soil around the tree with a solution of phenyl mercuri monoethanol ammonium acetate (see p. 120).

Aphids. Several species of aphids infest maple trees. Honeydew excreted by aphids is responsible for spotting of cars parked under street trees. Spraying with malathion, lindane, or nicotine sulfate is the control.

Cankerworms. Cankerworms sometimes feed upon maple trees. See Apple.

Cottony maple scale, *Pulvinaria vitis.* This is a brown, oval, soft scale on the bark of the branches of silver and red maple in winter, but in June the large egg-sacs are formed, and their wax covering resembles

a tuft of cotton. The young crawl in July and some of them live for a time on the leaves, but return to the twigs to pass the winter.

The best means of control seems to be a spray of miscible oil, 1 part in 15 parts of water, applied in early spring. However, sugar maple trees should not be sprayed with oil mixtures on account of danger of injury. (See figure 84.) Malathion sprays early in July will kill the young crawlers.

Figure 84. Cottony maple scale.

Flatheaded borer. See Apple.

Gall mites. On maple leaves there are several forms of galls caused by mites. Some of the more common of them are the maple leaf spot gall, *Cecidomyia ocellaris,* on red maple; the maple bladder gall, *Vasates quadripedes,* and the maple spindle gall, *Phyllocoptes quadripes,* on silver maple; and the gouty vein gall, *Dasyneura communis,* on sugar maple. Experiments show that the maple bladder gall can be controlled by a dormant spray of lime sulfur in early spring. Spraying with malathion early in May will also be helpful in destroying the mites before galls are formed.

Green-striped mapleworm, *Anisota rubicunda.* The caterpillars of this insect feed upon maple foliage, occasionally defoliating trees. When full grown it is about 1½ inches in length, pale yellowish-green, striped lengthwise with narrow light green and darker green stripes. There are two black spines on the second segment back of the head. The moth emerges in June, has a wing spread of about 2 inches, and is pale pink. A broad pale-yellow band crosses each forewing diagonally. Spraying with DDT, lindane, or lead arsenate will prevent defoliation.

Japanese beetle. See Rose.

Sugar-maple borer, *Glycobius speciosus.* This is the most destructive pest of the sugar maple. It is a beautiful black beetle with brilliant yellow decorations, including a W-shaped mark across the base of the wing-covers. It is about an inch in length and emerges in July. The female lays eggs in slits in the bark, and the young larvae tunnel in the inner bark and sapwood, hibernate in a chamber excavated in the sapwood, and the following spring cut large galleries in various directions, though usually in a spiral course upward and partly around the trunk. Sometimes two or more borers in a tree may completely girdle the trunk and the tree breaks over. They hibernate the second winter in chambers 4 inches from the bark. Two years are required to complete the life cycle. Tree growth over the wound generally results in a series of scars and ridges that show prominently on the trunk (See figure 85).

Choice shade trees may be examined carefully at least twice a year, in September and May, for sawdust on the bark. When a burrow has been discovered the grubs may be cut out, killed by running a wire into the burrow, or by injecting carbon disulfide or strong nicotine sulfate. The opening to the burrow may then be closed. Recent tests with DDT indicate that sprays of the bark may be effective in killing beetles.

Figure 85. Maple borer.

Maple leaf scale, *Pulvinaria acericola.* This scale closely resembles the cottony maple scale to which it is closely related, but differs

from it in that the egg-sacs are formed on the leaves instead of on the bark. This insect is not very abundant, but occurs on the sugar maple. The eggs hatch in late May or June and the scales live upon the leaves until October when they migrate to the trunk where they hibernate on the bark. If control is necessary a dormant spray of lime sulfur will prove effective. When the eggs are hatching late in May, malathion spray should give good control.

Maple petiole-borer, *Caulocampus acericaulis.* In certain years under sugar maple trees one may see on the ground, the last of May, many fallen green leaves with their stems severed a half inch or less from the blade. The blades drop first and a few days later the stems fall. The insect responsible for this injury is a small sawfly that lays an egg in the leaf stem and the larva tunnels in the stem and just before maturing cuts it off. The larva drops and enters the ground to pupate and remains there until the following spring. No control measures have been developed for this pest. If it becomes highly destructive, spraying with DDT as the leaves are opening might be effective.

Maple sesian, *Sesia acerni.* The larva of this clear-wing moth is a borer in maple trees, especially around wounds. There is one generation each year. The moth has a wing spread of about an inch; both fore and rear wings are transparent with narrow purplish margins, tips of forewings are pale yellow, the discal mark is large and black. Prevention of injury will be helpful in keeping the larvae out of the trees. Keeping all trees in a thrifty condition has aided materially in reducing borer injury. A DDT spray or bark wash may be expected to kill the moths before egg laying commences. A more thorough control would be expected if treatments were made several times at about 6-week intervals.

Norway-maple seed pod borer, *Nepticulr sericopeza.* This insect injures and cuts off the leaves of Norway maple in a manner quite similar to that of the sawfly borer in the leaf stems of sugar maple. The adult is a tiny moth. It commonly infests the seed pods and sometimes the leaf stems, causing many leaves to drop. This pest is usually not abundant enough to require control. Spraying with DDT or malathion late in May should control it.

Oystershell scale. The oystershell scale occasionally infests maple and many other trees. See Lilac.

Saddled prominent. The caterpillars of this insect occasionally become so abundant as to defoliate large areas of woodland, especially beech, birch, and maple. See Beech.

Figure 86. Terrapin scale.

Terrapin scale, *Lecanium nigrofasciatum.* This small, reddish, oval, convex scale occurs on the small twigs of hard and soft maple, often killing them. It varies from one-sixteenth to one-eighth of an inch in length and is usually reddish-brown mottled with black. Eggs are deposited in June under the old shells and there is one generation each year. (See figure 86). Miscible oil 1 part in 15 parts water, may be applied in early spring to silver and red maples, but on hard maples it is safer to use a spray of malathion in April.

White-marked tussock moth. The caterpillars of this insect feed upon maple foliage. See Horsechestnut.

Woolly maple leaf scale, *Phenacoccus acericola.* This scale infests sugar maple, and there are said to be three generations each year. On the undersides of the leaves in summer may be seen masses of white wax one-fourth inch or more in diameter, resembling tufts of cotton or wool, containing the living or dead female and about 500 eggs. When mature the males crawl into the crevices of the bark and transform in white cottony wax cocoons. The adults emerge 2 weeks later. At the approach of winter the immature females crawl into the crevices of the rough bark of trunk and branches, and there secrete wax to form protecting cases in which they pass the winter. They often emerge on warm days and crawl about the bark. The white woolly cases are always noticeable in the crevices of the bark at the

base of the larger branches and on the upper portion of the trunk on infested trees. (See figure 87).

This insect can best be controlled by a dormant spray of lime sulfur in late winter or early spring. Spraying with malathion or nicotine sulfate and soap when the young are crawling about will be helpful in control.

Figure 87. Woolly maple leaf scale.

Marguerite

Chrysanthemum leaf miner, *Phytomyza chrysanthemi.* This leaf miner evidently prefers the leaves of marguerite and commonly infests them, but also sometimes injures chrysanthemum. The eggs are laid singly within the leaf by a gray fly about one-twelfth of an inch in length. The eggs hatch in about 5 days and the larvae mine in the leaves, become mature in about 18 days and pupate in the mines. About 2 weeks later the flies emerge. As a control measure, a spray of nicotine sulfate, lindane or malathion applied at intervals of about 10 days may be used.

Marigold

Stem rot, *Phytophthora cryptogea.* Brown or black lesions, which may penetrate to the pith, appear on the stem near the soil line. Roots may be partially or entirely decayed. Planting marigolds in soil where the disease has not occurred is preferable. If lesions are found when very young, plants may be protected with repeated sprays of zineb, covering the lower stem and soaking the ground around plants.

Wilt, *Fusarium* sp. Plants wilt and die. Roots are rotted, and brown vascular bundles are seen if the stem is cut across. The fungus inhabits the soil and enters plants through root injuries. Wilting may be due to other causes so that laboratory examination is necessary. Planting marigolds elsewhere or sterilizing soil (see p. 4) before planting gives effective control. Roguing and burning infected plants reduces the amount of infective material.

Aster yellows. Virus. Green or greenish flowers together with a witches'-broom appearance of plant indicates infection by this virus. Immediate roguing and burning of all infected plants including infected weeds or ornamental hosts nearby helps eliminate new infections. Control of leafhoppers is essential to prevent spread.

Potato leafhopper. See Dahlia.

Imported long-horned weevil. See Pansy.

Tarnished plant bug. See Celery.

Meadow

Armyworm, *Cirphis unipuncta.* In certain seasons grasses and grains are stripped of leaves and heads during July by brown, striped caterpillars. When abundant, entire fields are stripped. The caterpillars then move in masses seeking other fields. The caterpillars reach a length of about 1½ inches. They feed chiefly at night and in cloudy weather. The moth has a wing spread of 1¾ inches with brown forewings and gray hind wings. In meadows to be cut for hay, the use of a commercial dry cutworm bait should control armyworms. If the meadow is not used for hay or pasture, spraying or dusting with DDT will kill the armyworms and help protect cultivated crops growing nearby.

Figure 88. Armyworm.

Cutworms. Besides the armyworms, there are a great many species of cutworms and their numbers vary greatly from year to year. The eggs of most of these are laid in grassland where the insects develop and then move to nearby cultivated crops, of which they feed on a large variety. The mature caterpillars are all about 2 inches long but differ in color and markings. There is usually only one generation a year. Cutworms are preyed upon by many insect parasites which usually keep them in check. Control is usually unnecessary in meadows. The use of cutworm bait along the edges of the meadow should prevent migration of cutworms to cultivated crops.

Grasshoppers. Several species of grasshoppers may be sufficiently abundant to cause injury by feeding upon grasses. The principal offenders are the red-legged grasshopper, *Melanoplus femur-rubrum,* the two-striped grasshopper, *Melanoplus bivittatus,* and the lesser locust, *Melanoplus atlantis.* Control is usually not required. Use of cutworm bait around the margins of meadows should control grasshoppers migrating to cultivated crops.

Leafhoppers. Many species of leafhoppers feed upon grasses by sucking sap from the leaves and stems. The most abundant are the inimical leafhopper, a small form with translucent wings and a yellow head with black spots; and the irrorate leafhopper, larger and with head and wings brown, flecked with minute darker spots. Some of these leafhoppers may transmit virus diseases from roads in meadows to cultivated crops.

Meadow spittlebug, *Philaenus leucophthalmus.* The adult spittlebug is a stout, winged insect about one-fourth inch long. It is commonly brownish with clear spots, but its color and color patterns may vary from light to solid black. Greatest damage is caused by nymphs which suck plant juices from inside the characteristic white spittle masses (mixtures of air and fluid) in which they live (see figure 3.) The adults also feed on plant juices but do not produce spittle. The adults are active until cold weather. The insect overwinters as eggs on the stubble of grasses and legumes. There is one generation a year. Damage is usually severe only to the first cutting and this can be protected by spraying with heptachlor when new growth starts in the spring and before plants are more than 6 inches tall.

Plant bugs. Several species of plant bugs, including the tarnished plant bug *Lygus oblineatus,* and the four-lived plant bug, *Poecilocapsus lineatus,* breed freely in meadows. The damage they cause is insignificant, but they may migrate to cultivated crops.

White grubs. The grubs of several species of May or June beetles feed upon the roots of grasses in fields and meadows. In occasional seasons, root damage may be severe and large dead patches will appear, particularly on high ground in dry weather. The beetles range in size up to three-quarters of an inch long and are brown in color. Most of the beetles require 3 full years to develop from egg to adult, and most of the injury to grassland occurs during the second season the grubs. The adults do not feed on grass. See Lawns.

Wireworms. Several species of wireworms find permanent sod land very suitable and may build up large infestations. The larval stage may extend over two or three seasons. These insects cause some damages to meadows, but are a more serious pest of crops planted the first season after plowing the meadow. They are especially destructive to potatoes, tobacco, and vegetables. For control see Potatoes and Tobacco.

Melon

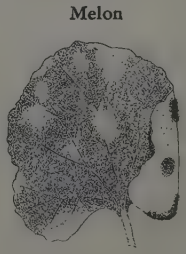

Figure 89. Downy mildew on melon.

Hop flea beetle. This insect may occasionally feed on melon. See Cabbage.

Melon aphid, *Aphis gossypii.* This aphid infests many different kinds of plants both in the field and in greenhouses, but it is particularly troublesome on cucurbits. It generally makes its appearance in scattered places in the field late in the summer and soon becomes abundant on the undersides of the leaves. These soon curl and the vine becomes too stunted to produce a crop, or per-

haps wilts and dies. Control by dusting or spraying with malathion has been satisfactory.

Melonworm, *Diaphania hyalinata.* On occasion, melon may be injured by slender, active greenish caterpillars with two narrow white stripes running the full length of their bodies. They feed mostly on the foliage, but may burrow into the fruit. They are rare, however, and no specific control measures have been needed.

Pickleworm, *Diaphania nitidalis.* The pickleworm, which is somewhat heavier, less active and bears a row of black spots instead of the white stripe of the melon worm, may also infest melons and other curcurbits. See Cucumber.

Striped cucumber beetle. This beetle may injure young melon plants. See Cucumber.

Mignonette

Cabbage looper. The caterpillars sometimes feed upon mignonette. See Cabbage.

Corn earworm. The caterpillars when very abundant occasionally feed upon mignonette. See Corn.

Millet

See **Small Grains.**

Mint

Rust, *Puccinia menthae.* Mint rust may become serious if plants are crowded. Light yellow or brown spots appear on stems and leaf stalks or main veins of leaves in early summer. Cleaning up plant refuse in the fall and spraying ground with DN (as described under Beebalm) before growth starts in spring give good control.

Anthracnose, *Sphaceloma menthae.* Brown sunken spots on leaves, stems, or stolons become pale tan with dark reddish borders. Heavy infection may kill plants outright or so debilitate them that they fail to overwinter. Careful disposal of old mint stems, leaves, and stolons in the fall gives adequate control.

Wilt, *Verticillium* sp. Plants are slow to grow in the spring and have a bronze cast. Lower leaves yellow with warm or dry weather, and plants die. The fungus is carried in the soil, and no control is known other than to avoid planting mint in infested soil. Soil sterilization (see p. 4) is sometimes necessary because the organism persists many years.

Mockorange

Leaf spots uncommonly found on mockorange may generally be controlled by cleaning up diseased leaves and twigs and removing them. Or sprays of ferbam, thiram, or Bordeaux may be applied to leaves when half grown and again when full grown.

Aphids. The bean aphid and the green peach aphid sometimes infest the tender shoots. A spray of nicotine sulfate and soap, malathion, or lindane will kill them.

Leaf miner, *Agromyza melampyga.* The larva of this fly at first makes a curved linear mine in the leaf, but later the distal end of the mine expands into a blotch an inch or less in length and half as wide. Spraying with lindane or malathion should give good control.

Monkshood (Aconite)

Crown rot, *Sclerotium delphinii.* Plants wilt and die and are covered at ground level with white mold containing seed-like sclerotia which range from buff to reddish-brown. Early infections may sometimes be halted by drenching the soil around the plant with bichloride of mercury solution 1:2000 (see p. 78). Removal of dead plants and the surrounding soil that contains sclerotia is otherwise indicated. If sclerotia are not found, the causal organism may be *Rhizoctonia solani* and several applications of oxyquinoline sulfate may be helpful. (See p. 5.)

Planting in sterilized soil will avoid both troubles.

Wilt, *Verticillium albo-atrum.* Plants are slow and small. Lower leaves yellow, and plants wilt and die. Black streaking in vascular bundles of stem indicate the work of this fungus. Planting in sterilized soil will prevent this disease. Once present in a garden other susceptible species may contract the disease if put in the same location. Use of clean soil is indicated.

Morning-glory

Leaf miner, *Bedellia sommulentella.* The larva of this small moth makes a serpentine mine in the leaves, sometimes involving a large proportion of the leaf tissue. When mature it emerges from the mine, transforms, and suspends its slender angular cocoon from the leaf by a few silk threads. In a few days the small gray moth emerges. A spray of lindane or malathion when required will kill them.

Morning-glory leaf cutter, *Loxostege obliteralis*. The insect cuts the leaf stalks, causing the leaves to wilt. The greenish caterpillars hide during the day and feed only at night. Holes may also be eaten in the leaves at this time. The moths are yellowish with some light brown markings. Spraying or dusting with DDT, malathion, or lead arsenate will kill the larvae.

Tortoise beetles. The leaves of Convolvulus and Ipomoea are sometimes eaten by tortoise beetles. Usually control measures are unnecessary, but in case severe injury is feared, a spray of lead arsenate, DDT, or malathion may be applied to protect the foliage.

Mountain-ash

This ornamental tree is susceptible to many of the diseases of apple, particularly fire blight, black rot, and rust. See Apple.

Mountain-ash sawfly, *Pristophora geniculata*. Young larvae are greenish white, with black head and legs and black dots on the body. Fully grown larvae are almost three-fourths of an inch long, yellowish, with orange-yellow heads and legs, black eyes and black spots on all but the last segment. The adult sawflies emerge late in the spring. Larvae feed during the summer and drop to the ground to pupate over the winter. There may be a partial second generation. DDT, malathion, or lead arsenate sprays will control this pest.

Pear leaf blister mite. See Pear.

Roundheaded borer. Mountain-ash trees are sometimes severely injured by this insect. See Apple.

San Jose scale. This scale infests mountain-ash. See Pear.

Scurfy scale. This scale also occurs on mountain-ash. See Pear.

Woolly aphid. The bluish white woolly colonies of this aphid are often seen on the leaves and branches of mountain-ash. See Apple.

Mountain-laurel

Leaf spot, *Phyllosticta kalmicola*. Circular or irregular brown spots with purple borders are typical of this fungus. Tiny black pustules are peppered over the spots. Infected leaves are unsightly. Control is obtained by spraying new growth when half grown and again when full grown with fer-bam, thiram, or Bordeaux plus a sticker-spreader. Removal of diseased leaves help control this fungus on laurel and other members of the Heath family. Several other leaf-spotting fungi may be found on laurel, but control is the same.

Leaf scorch and dieback, *Rhizoctonia solani*. New leaves may appear scorched or a mottled green and yellow, with or without burnt tips accompanied by dieback of branches. Very fine roots are rotted off, and the larger fibrous roots are entirely or partly brown. Laboratory examination is necessary to determine the agent responsible for the trouble. Similar symptoms may be produced by too much fertilizer or by injury to the roots, whether from grubs, borers, or mice. A careful examination of the bush and soil around it will often reveal other causes (See shoestring rot).

In cases involving *Rhizoctonia*, a soil treatment with oxyquinoline sulfate (see p. 5) is usually sufficient to halt the trouble. Two or more applications may be necessary in severe infections.

Shoestring root rot, *Armillaria mellea*. Symptoms of attack of this fungus on the roots are similar to the preceding disease, but the causal agent and control are different. The shoestring fungus usually penetrates the bark at ground level and may be recognized by the white mycelial fans found under the bark or the long black shoestring-like rhizomorphs in or under the bark or in the soil.

If infection has not progressed too far, the shoestring fungus can be kept under control by drenching the soil around the bush with a solution of phenyl mercuri monoethanol ammonium acetate at the same concentration as is specified on the label for control of apple scab. A thorough watering of the bush gives adequate control.

Blackvine weevil. See Taxus.

Mulberry whitefly. In certain localities the undersides of the leaves of mountain-laurel become literally covered with the nymphs of this insect. See Mulberry.

Rhododendron lacebug. This lacebug commonly infests mountain-laurel in nurseries and ornamental plantings. See Rhododendron.

Mulberry

Bacterial blight, *Phytomonas mori*. Ir-

regular dark green sunken spots on leaves become brown or black with yellow borders and translucent edges. Young leaves may be deformed and browned. On young shoots infection shows as watersoaked streaks which eventually kill the twig. Yellow or white masses of bacteria may ooze from lenticels under moist conditions, or from cut stems. Pruning and burning infected parts reduces chance of further infection. Agri-mycin sprays may be tried experimentally when leaves are half grown and again when full grown or as soon as the disease is noted.

Powdery mildew, *Phyllactinia suffulta.* Whitish mealy appearance of the underside of the leaves usually indicates presence of this fungus. Sprays or dusts of sulfur applied early in the season give good control.

Hickory borer. This insect is also a borer in the trunk of mulberry. See Hickory.

Mulberry whitefly, *Tetraleurodes mori.* This whitefly was named from the mulberry, presumably because mulberry leaves are commonly infested and a favorite host, although the insect occurs on many other kinds of trees and shrubs. The oval nymphs or larvae occur on the undersides of the leaves, and are dark brown or black, fringed with marginal white wax wings spotted with red and brownish black. Usually control measures are not employed, but a spray of malathion will destroy the insects.

N

Narcissus

For diseases see Daffodil.

Bulb fly, *Lampetia equestris.* The maggot of this fly infests the bulbs and ruins them. There is only one maggot in a bulb, and the insect has one generation each year. The larva hibernates in the bulb, and pupation occurs in the spring in the old burrow or nearby in the soil. The adults appear in early summer and lay oval white eggs near the base of the leaves or on exposed portions of the bulbs. The maggot is a yellow or dirty white larva without legs. It is about three-fourths of an inch in length. The fly is about half an inch long, black, and banded with yellow or gray, is hairy and resembles a bumblebee.

Destroy all infested bulbs after digging. One and one-half hours of hot-water treatment at 110° F. will be helpful in control. Calcium cyanide used at the rate of 16 ounces per 100 cubic feet of space for four hours at 75° F. has proven successful fumigation in closed areas. Control of the insect in growing plants is not easy. Small, stunted and otherwise obviously infested plants may be dug up and burned, thus preventing the spread of the infestation.

Bulb mite, *Rhizoglyphus echinopus.* This mite injures nearly all kinds of bulbs, and Easter lily plants in greenhouses have been severely injured. The mites breed continuously in greenhouses or wherever the temperature and moisture are sufficiently high, and it is possible for 10 or more generations to mature in a year. When the conditions become unfavorable to the mite, such as lack of food or moisture, a resistant stage called hypopus is formed, adapted for migration to fresh food supplies.

The control measures are: Burn all soft and decayed bulbs; store bulbs at about 35° F.; immerse all infested bulbs for 10 minutes in nicotine sulfate, 1 part in 400 parts water, at a temperature of 110° F., or 2 per cent formalin solution for the same time and temperature. See also bulb fly, above.

Lesser bulb fly, *Eumerus tuberculatus.* This fly is also a pest of onion, but narcissus is the plant most severely injured by it. It is believed that there are two generations each year. The flies appear in May and June and lay eggs at the base of the leaves. The larvae find their way to the tip of the bulb and then go downward into the interior. As many as 77 larvae have been found in a single bulb. When fully grown these maggots are between one-third and one-half inch in length, wrinkled and dirty grayish yellow in color. They pupate in August in the bulb or in the soil near it. Certain larvae hibernate in the bulbs, but these are thought to be the second generation, from which flies emerge the following spring. The fly is about one-third of an inch long, and has gray wings, and a black abdomen marked with three white crescent-shaped bands.

See bulb fly for control.

Nasturtium

Wilt, *Pseudomonas solanacearum.* Plants yellow, wilt, and die. Stems show black streaks, and bacterial slime oozes from cut stems. The bacteria are carried in the soil and infect nasturtiums through the roots. Planting in clean soil gives best control. Nasturtiums may also be attacked if they follow other plants that are susceptible to the same disease, i.e., tomatoes, potatoes, eggplants, zinnias, dahlias, chrysanthemums, and marigold.

Bean aphid. This aphid frequently infests nasturtium plants. Spraying every 2 weeks with malathion or lindane is the control.

Serpentine leaf miner, *Liriomyza pusilla.* The larva of this fly makes a serpentine mine in the leaf of nasturtium. The turnip leaf miner and the columbine leaf miner (see columbine) have been recorded as occasionally infesting nasturtium. Usually no control is necessary. A spray of lindane or malathion will control these miners.

Figure 90. Anthracnose on white oak.

Figure 91. Anthracnose on red oak.

Oak

Anthracnose, *Gnomonia veneta.* White oak leaves brown and curl from the edges inward, progressing upward from the bottom of the tree. On black and red oaks infection shows as small or large irregular brown spots that often enlarge along the veins. The same fungus causes a similar disease and leaf drop on sycamores. Sprays of zineb, dichlone, ferbam, thiram or Bordeaux plus spreader-sticker give effective control if applied when leaves are half grown and again when full grown.

Leaf blister, *Taphrina caerulescens.* Light green or whitish raised puckered areas appear on leaves in mid-summer. Leaves drop. Full dormant sprays of zineb, Bordeaux, or dichlone prevent this trouble. Lime sulfur is effective but will blacken white house paint, so that the other sprays may be more desirable.

Powdery mildew, *Microsphaera alni.* Whitish mealy appearance of upper surface of leaves is characteristic of infection by this fungus. In the fall, small black dots which are the fruits of the fungus may be found embedded in the white mycelium. Although widespread and common this fungus is generally ignored. Sulfur sprays or dusts applied in mid-June and every 2 weeks thereafter should give effective control if desired.

Leaf spot, *Monochaetia desmazierii.* Leaves show large greenish or brown spots with reddish or purple borders. Ordinarily the pest is not very serious. Sprays for anthracnose will control it if desired.

Twig canker and dieback, *Diplodia longispora.* Twigs and small branches are killed. Leaves dry up but remain attached to the tree. Infected sapwood shows black streaks. Black fruiting bodies may be found on the twigs. This disease is apt to occur on oaks in poor condition for some other reason, often a change in stand, a severe drouth, or attack on the roots by the shoestring fungus. Correction of the fundamental trouble

Figure 92. Leaf blister on white oak.

may be impossible, but pruning and burning dead wood and three sprays of dichlone applied when buds break in spring and again when leaves are half and full grown give fairly good control.

Figure 93. Strumella canker on oak.

Strumella canker, *Strumella corynoides.* This fungus occurs most frequently on forest trees but may become important on ornamental red and scarlet oaks. Infection usually is first noticed as a depressed area at the base of a branch stub which enlarges in a target-like fashion with concentric callus ridges until the trunk is either girdled or considerably bowed on the opposite side to the canker. The original infection on the branches, consisting of yellowish-brown depressed or raised areas on the bark, usually passes unnoticed. The fungus travels rapidly down the branch into the trunk, forming the canker which withers, deforms, or kills the tree.

Removal of trees as soon as infection is noticed helps protect remaining trees because the fungus fruits mostly on dead trees. If cankers are small, an attempt may be made to cut them out, cleaning away all discolored wood, pointing at the top and bottom, and painting with a good tree paint. This treatment is not always successful.

Shoestring root rot, *Armillaria mellea.* Infection by this fungus usually is first noticed as a general off-condition of the tree. Leaves are smaller than normal with little or no new growth, and finally dieback occurs. Bark at the ground level and on affected roots is loose. On the inside of pieces of scaled bark may be found white fans of fungus mycelium with or without black shoestring-like cables of fungus threads called rhizomorphs. Rhizomorphs may run under or along the bark of trunk and roots or in the soil.

Armillaria mellea, the Shoestring fungus, is present in most woodlands as a destroyer of dead stumps and roots and may be found in many lawn soils, particularly if the land was formerly in woods. It is easy to see how the fungus may be brought into home plantings with laurel and other woody plants. The fungus may maintain itself around apparently healthy trees and is considered a weak pathogen on living plants. Trees or shrubs may become susceptible to attack because of other factors which put them in a weakened condition, such as attack by leaf-eating insects, leaf-spotting or other fungus diseases, drouth, lightning, or other unfavorable changes in environment. Trees outside their natural range are liable to be attacked. Finding the rhizomorphs around a dying tree is reasonably good proof of the cause of the trouble.

We have found organic mercury fungicides applied as a soil drench to be effective in treating infection by *Armillaria mellea* on such widely divergent plants as lilac, laurel, and oak. This treatment is for use on ornamentals only.

Phenyl mercuri monoethanol ammonium acetate gives good control of this disease when flooded into the soil around the affected tree or shrub by means of a subirrigation gun. This material is commonly used as an apple scab eradicant spray and the concentration as given on the label for apple scab control will check shoestring root rot. Application may be made any time of year.

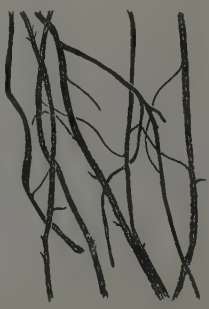

Figure 94. Rhizomorphs.

Treated trees and shrubs recover if the material is applied in time. One application will suffice. *Caution*: This material is very poisonous and under no circumstances should it be applied to the soil around trees or shrubs that produce edible fruit.

Basal canker, *Bulgaria inquinans.* These cankers may superficially resemble a crack in the bark, but examination shows that the fungus has killed the wood under the bark and may girdle the tree. Fruiting bodies are distinctly stalked cups or saucers, dark brown on the outside and black inside, which appear in the cracks in the bark. Removal of infected bark and wood and painting of wounds with a good tree paint are indicated.

Wilt, *Endoconidiophora fagacearum.* Oaks of the black and red groups are susceptible to oak wilt. Young leaves turn black and remain attached to the tree; older leaves may turn bronze and fall. Petioles are discolored interiorly as is the wood, which shows brownish-black streaks. The entire tree may die in a few weeks, and grey mycelial mats may be found under the bark of trees dead over 3 months.

Since the disease is believed to be carried by bark beetles and borers as well as root grafts, insect control and prompt removal of all infected trees is essential. To date no incidence of oak wilt has been reported in Connecticut. Laboratory verification is indicated at this time.

Aphids. Several species of aphids occur on the twigs and leaves of various species of oak in Connecticut. Control measures are necessary only in case of severe infestation when a malathion, lindane, or nicotine sulfate and soap may be applied.

Broad-necked root borer, *Prionus laticollis.* The grub of this beetle is a borer in the roots and stumps of oak and several other kinds of trees. It is a white fleshy grub without legs and when full grown reaches a length of nearly 3 inches. The adult is a dark brown, long-horned beetle about 1½ inches in length, and emerges in July. No control measures are required.

Cankerworms. Cankerworms often feed upon oak as well as many other kinds of fruit, shade, and woodland trees. See Apple.

Gypsy moth, *Porthetria dispar.* Oak is a preferred host of the gypsy moth, and solid stands of oak are subject to periodic defoliation.

When fully grown, the caterpillars are between 2 and 3 inches in length, dark gray or brown with prominent light brown hairs. Some have a light narrow stripe along the back and all have two rows of tubercles bearing hairs. From the head the first five pairs are blue, and the remaining six pairs are brick red. They feed during May and June, and do most of their feeding at night.

They pupate in cracks or crevices spinning a very small amount of silk. The moths emerge in about 2 weeks. The female is buff with narrow zigzag lines across the forewings. The wingspread is about 2 inches, and the body is so heavy that the female cannot fly. The male is reddish-brown with variable light gray and dark brown markings and with a wingspread of 1 to 1½ inches. The males fly freely. (See figure 11).

Eggs are laid on the bark of trees, on stones, or lumber. They are laid in masses of about 400 eggs and covered with buff hairs from the body of the females. Individual shade trees may be sprayed with DDT or lead arsenate. Woodlands may be sprayed with one pound of DDT to the acre, using aircraft. See Circular 186.

Leaf miners. There are several leaf miners on oak, one of the most conspicuous being the white blotch leaf miner, *Lithocolletis hamadryadella.* Other species are *L. fitchella* and *L. tubiferella.* A spray of lindane, BHC, or malathion will give satisfactory control when treatment is made in late May or early June. Raking up all leaves and burning them in the fall will help to control the hibernating insects

Leaf mites. Mites often infest oak leaves, causing a rusty brown appearance. Mites have been successfully controlled by spraying with malathion or aramite.

Leaf rollers. Several species of leaf rollers occur on oak trees, and in 1930 there were several localities in Connecticut where black, white, red and pin oaks were partially or nearly defoliated. Spraying with DDT or lead arsenate will protect the foliage.

Lecanium scale. See Peach.

Oak galls. Oak trees are subject to galls and many different species are found upon them. Only a few of the more conspicuous

galls can be mentioned here. The large oak apple is a globular gall from 1 to 2 inches in diameter, occurs on black, red and scarlet oaks; the gouty oak gall appears as rough cylindrical galls surrounding the twigs on black, red and scarlet oak; the oak bullet gall is a smooth spherical gall half an inch in diameter, occurring on white oak; the oak seed gall is a mass varying from a half an inch to nearly 2 inches in diameter on white oak; and the white oak club gall, a woody swelling at the ends of twigs on white oak. Control is usually unnecessary.

Oak gall scale. Several species of gray or yellow globular scales occur on the twigs of various species of oak, usually in the axils of leaves or buds. Control has been obtained by a dormant spray with miscible oil, 1 part in 15 parts of water, applied in early spring.

Orange-striped oakworm, *Anisota senatoria.* This is a caterpillar striped lengthwise with black and orange, with short black spines on some of the segments, and two longer fleshy protuberances or horns back of the head. It reaches a length of about 1¾ inches and feeds on scrub oak and some other species, becoming mature in August. It hibernates as pupae in the soil and the moths emerge during June. There is one annual generation. The adults are a tawny orange color with a purplish diagonal line on each wing, and have a wing spread of about 1¾ inches. Spraying with lead arsenate or DDT will prevent defoliation.

Figure 95. Pit-making oak scale.

Pit-making oak scale, *Asterolecanium variolosum.* This is a green glossy circular scale partly sunken in the bark, that occurs on the English oak and chestnut oak. During the past few years it has become quite abundant on chestnut oak around New Haven. This scale is about one-sixteenth of an inch in diameter. It winters in a nearly mature condition and the young appear in May. (See figure 95). A malathion spray during May should control the crawlers.

Twig injury by squirrels. See Elm.

Twig pruner, *Hypermallus villosus.* Small twigs are constantly dropping upon the ground under the oak trees in July and August. Some of them hang with dried leaves and they have been cut off by the larva of this beetle. The eggs are laid in July on the smaller twigs, and the young grubs work for a time under the bark, then tunnel along the pith in the center of the twig. When nearly full grown the borer cuts off nearly all of the wood, and the twig, with the borer inside, breaks off in the wind and falls to the ground. The insect hibernates in the twig and the beetle emerges the following summer. The beetle is grayish brown, with body about five-eighths of an inch in length and long slender antennae. Gathering and burning the fallen twigs immediately will destroy the larvae. If further control is necessary, spraying with DDT or malathion during July might kill the beetles before eggs are laid.

Two-lined chestnut borer. This borer commonly infests oak. See Chestnut.

Walkingstick, *Diapheromera femorata.* Oak trees are occasionally partially stripped in September by green and brown stick-like insects called walkingsticks. Walkingsticks belong to the Orthoptera and are related to the grasshoppers. They feed chiefly on oak and there is one generation each season. Trees may be protected by a spray of DDT or lead arsenate, using aircraft if the acreage is large.

Yellow-necked caterpillar. See Apple.

Oats

See **Small Grains**

Okra

Aphids. The green peach aphid sometimes infests okra. Malathion sprays may be used if necessary.

Corn earworm. The corn earworm occasionally feeds upon okra. See Corn.

Oleander

Mealybugs. Mealybugs commonly infest oleander. See Lantana.

Soft scale. This scale infests oleander and many other greenhouse plants. See Fern.

Oleander scale, *Aspidiotus hederae.* This is a flat, nearly circular, dirty white or light gray scale that is common on the leaves of oleander and many other greenhouse plants.

Spraying with malathion three or four times at intervals of 10 days should be helpful in control. Aerosol bombs used for other greenhouse pests should control this scale.

Onion

Pinkroot, *Phoma terrestris.* Onions with pinkroot are stunted, and the tops wither early. The top symptoms are caused by the rotting away of the roots. Infected roots are pink to red in color before they decay. The disease is caused by a fungus which lives in the soil and is favored by heavy, wet soils. Certain crops such as ladino clover, ryegrass, and corn leave residues in the soil which are injurious to onion roots. This injury makes the onions more susceptible to the pinkroot fungus. The injurious effect of certain crop residues on the roots of following crops was demonstrated by V. W. Cochrane at this Station.

To prevent pinkroot, onions should be planted on well-drained soils, and should not follow certain crops such as ladino clover, ryegrass, or corn. A 4-year crop rotation is suggested.

Downy mildew, *Peronospora destructor.* This disease shows as yellow spots on the leaves. The fungus which causes this disease appears as a downy, purple growth on the yellow spots following wet weather. The fungus spreads very quickly during wet, warm weather and may destroy whole crops in a few days. The older leaf spots are often invaded by a second fungus which blackens the spots. Fortunately, downy mildew has not been too important in Connecticut in recent years. It has not been thought necessary to spray onions in Connecticut regularly to protect against mildew. Zineb, plus a good spreader-sticker, will afford some protection if needed.

Neck rot, *Botrytis allii.* This is a dry, brown rot of white onions in storage. The fungus which causes neck rot infects the onions at harvest time and grows in storage. The fungus carries over as hard, black kernels, which may be found in the rotted onions.

To keep the fungus out of the onions, it is best to allow the crop to mature as far as possible before havest. This makes the neck area small and dry, with less likelihood of infection. The harvested onions should be well dried before storing, and stored in a cool, dry, well-aired space.

Smut, *Urocystis cepulae.* This disease shows as black, smutty areas on the leaves, and in between the segments of the bulbs of *white* onions. These areas are filled with the loose, smutty spores of the fungus. Young diseased plants have twisted, curled leaves and may be killed outright. To control smut, treat seed of white onions with Arasan, and make certain sets are not infected.

Figure 96. Onion smudge.

Smudge, *Colletotrichum circinans.* The smudge fungus causes dry, black, target spots on the outer scales of *white* onions. The fungus infects in the field during the growing season. The disease is not prevalent in Connecticut and control measures are not required. It is best to plant on well-drained soil, and handle the bulbs as for the control of neck rot.

Garden springtail. This little springtail may damage young seedling onions. See Beet.

Lesser bulb fly. This insect also injures onion. See Narcissus.

Onion maggot, *Hylemya antiqua.* Onion plants are often severely injured by small white maggots that feed in the lower part of the stem or bulb. The flies appear in the fields in spring and lay eggs in the base of the leaf sheath near the ground. The young maggots work their way downward into the stem where they feed. Infested young plants may die outright, but in older plants the maggots burrow into the bulb and decay follows. Several maggots may infest a single bulb. There are two or three broods annually and the insect hibernates both as an adult, and in the pupal stage in the soil. Treating seed before planting with aldrin has given good control.

Onion thrips, *Thrips tabaci.* Thrips injury is called "white blast" because the seriously injured plants turn white due to

Figure 97. Onion thrips.

the devouring of the outer chorophyll-containing tissue. Thrips are very small insects with narrow fringed wings that are lacking in the nymphs. In feeding, a thrips leaves a whitish chain-like mark on the surface. They hide in the sheaths of the leaves and are rather difficult to reach with an insecticide. Dusting or spraying with DDT as necessary will control thrips.

Orchids

Brown rot, *Erwinia cypripedii.* Circular or oval greasy brown spots appear on leaves which rapidly become a deep chestnut. Lesions are sunken with well-defined margins. If temperature is 65° or above and humidity high, the disease progresses rapidly to the growing point, and plants droop.

Good aeration and avoiding syringing help prevent this disease to a large extent. Submerging plants for several hours in a solution of oxyquinoline sulfate or benzoate 1:2000 or o-hydroxydiphenyl (sodium salt) as directed on the package effectively cures plants.

Brown spot, *Phytomonas cattleyae.* This bacterial spot is very serious on *Phalaenopsis,* attacking seedlings in community pots or mature plants. It starts as a green water-soaked spot which becomes brown and eventually black. Seedlings may be decimated by the disease, and mature plants can be killed when the bacteria reach the growing point. On *Cattleya* the discoloration is more limited, appearing usually on older leaves, and lesions are black and sunken. Overhead irrigation serves to spread the disease.

Local applications of bichloride of mercury 1:1000 with a cotton swab are repeated several times for good control. *Phalaenopsis* seedlings and mature plants have been cured by soaking the pots several hours as described under brown rot. It may be necessary to repeat the treatment.

Anthracnose, *Gloeosporium* sp. and *Colletotrichum* sp. Spots may occur on leaves or tubers and vary from yellowish to light brown, are more or less circular, soft and sunken. Spore pustules are pinkish or reddish-orange and often arranged in concentric rings.

Since syringing spreads spores which cause new infections, avoiding overhead sprinkling is important. Reducing humidity by improving ventilation is indicated. Cutting and burning infected leaves will remove a source of future trouble. Sprays of Bordeaux, thiram, or ferbam will help protect plants, but a spreader is needed to obtain good coverage. Other fungi may cause leaf spots on orchids: *Cercospora* sp., *Phyllosticta* sp., *Physalospora* sp. Methods of control are as for anthracnose.

Root rot, *Rhizoctonia* sp. Plants yellow and wilt, and a brown mycelium can be found on tubers and basal portion of leaves. It is apt to be particularly virulent if the nutrition level is high. Treatment of plants with oxyquinoline sulfate as described under brown rot gives good control.

Petal blight, *Sclerotinia fuckeliana, Botrytis* stage. Spots on petals rapidly enlarge and rot the entire flower. A grey fuzzy mold is produced on the infected tissue if high humidity and low temperatures persist. Destruction of diseased flowers removes some of the source of the trouble. Keeping temperatures high and improving ventilation by opening the vents a little is helpful.

Foliar nematodes, *Aphelenchoides fragariae.* Brown or blackish spots delimited by veins eventually cause leaf drop. Flower buds may be deformed. This same nematode infests fern leaves. Since nematodes are spread by splashing water, careful watering is essential. Improved ventilation permits water to evaporate from plant parts quickly, and nematodes cannot spread easily.

Mosaic, ringspot. Viruses. Either color-breaking in flowers or mottling of leaves with yellow and green blotches or streaks

indicates virus infection. Some viruses cause ring-like concentric patterns in leaves, either yellow or brown, and necrosis may follow. Since it is apparent that juice transmission is the fact, it is essential to rogue and burn diseased plants, and isolation of suspicious and all new plants until symptoms have a chance to appear is helpful.

Oxalis

Rust, *Puccinia sorghi.* Neat yellow dots on leaves near margins break out as orange pustules. The alternate host may be corn or a grass. Since the fungus does not spread on oxalis, spraying for control has to take place before infection. Zineb or ferbam sprays are indicated.

P

Pachysandra

Leaf blight and canker, *Volutella pachysandrae.* Leaves turn brown with irregular blotches, and shrivel. Lesions appear on the stem on which may be found pink masses of spores. Since this trouble is more apt to spread in a thick planting, thinning will be helpful. However, removal of dead leaves and plants is essential, and good control includes spraying with Bordeaux mixture.

Root rot, *Rhizoctonia* sp. Plants wilt and die. Examination reveals fine roots are rotted, and stolons and larger roots have dark brown lesions on which brown mycelium is growing. Several applications of oxyquinoline sulfate 1:4000 (see p. 5) to affected area will usually help plants to recover.

Euonymus scale. Pachysandra is often severely infested by this scale. See Euonymus.

San Jose scale. Occasionally this scale infests pachysandra. See Apple.

Oystershell scale. See Lilac.

Palms

Scale insects. Many kinds of scale insects infest the different species and varieties of palms in greenhouses and dwellings. Some of the more important of them are as follows: Mealybugs, hemispherical scale, soft scale, circular scale, Morgan's scale, and thread scale.

Spraying with malathion three to four times at 10-day intervals will be helpful in destroying the pests. Perhaps a repetition of the schedule twice during the year will give lasting control of the insects in greenhouses. Aerosol bombs will give added benefits.

Pansy

Grey mold, *Botrytis cinerea.* Flowers and buds rot and may be held together with a greyish mold. In crowded situations the entire plant may be involved. No known spray gives effective control of this fungus. *Botrytis* thrives in prolonged cool, wet weather, so that raising the temperature or lowering humidity has proven helpful.

Root rot, *Thielaviopsis basicola.* Plants are stunted, leaves turn yellow and die. This soil fungus rots the roots and progresses upward into the stem. Planting healthy plants in sterilized soil is the only known control.

Root-and-crown rot, *Rhizoctonia solani.* Plants are slow growing and eventually wilt, yellow, and die. Dead plants are easily pulled from the ground, often separating at the ground level. Brown mycelium can sometimes be found on the stem.

If plants are lightly infected a soil drench of oxyquinoline sulfate (see p. 5) will help them to reestablish themselves. If infestation has been severe, two or three applications are indicated for protection of remaining plants.

Powdery mildew, *Sphaerotheca humuli.* A whitish mealy appearance of the leaves is characteristic of this trouble. Sprays or dusts of sulfur applied before infection occurs usually prevents infection.

Anthracnose, *Colletotrichum violae-tricoloris.* Tan spots with black borders appear on leaves, stems or flowers. Plants may be killed in bad infections.

Removal of infected plants eliminates a considerable source of the trouble. Sometimes, however, new soil is preferable to old infested soil. Other fungi, spp. of *Alternaria, Cercospora,* and *Phyllosticta* cause leaf spots. Control is essentially the same as for anthracnose. In the past Bordeaux has been used sparingly because of plant injury. Perhaps zineb, captan, or thiram would give effective control.

Scab, *Sphaceloma violae.* Irregular or elongated yellow or whitish spots appear on leaves, stems, sepals or any green part of the plant. When stems are girdled, plants die. Sprays of zineb may give adequate control.

Foliar nematodes, *Aphelenchoides fragariae.* From a distance plants look dwarfed: leaves at the growing point are distorted, base of leaf stalks may be swollen, and internodes shortened. Planting clean plants in sterilized soil (see p. 4) eliminates danger from this pest.

Wilt, *Fusarium violae.* Plants wilt and die. Vascular discoloration usually appears in the cut stem. Soil sterilization (see p. 4) before planting eliminates the fungus.

Cutworms. Certain kinds of cutworms occasionally feed upon the leaves and flowers of pansy plants in greenhouses and cold-

frames. Considerable injury has been caused by small cutworms that fed at night and during the day were coiled up in the soil around the plants. The plants may be sprayed with DDT or lead arsenate.

Garden slugs. Pansy plants are often injured by garden slugs. See Lettuce.

Greenhouse or celery leaf-tier. This insect is on record as having caused severe injury to pansy under glass. See Cineraria.

Imported long-horned weevil, *Calomycterus setarius.* The greyish-colored adults are about one-eighth inch long. They emerge from late June through July and early August. Eggs are laid in the soil and larvae are present from mid-summer until June of the following year. They feed on the small roots of host plants but more often on those of legumes and organic matter. Both wild and cultivated plants are attacked. The adults feed in the sunlight or shade usually on the upper surface or edge of the leaves and flowers. Host plants include annuals, perennials, shrubs, deciduous trees, and evergreens. Treating the soil with chlordane, dieldrin, or DDT will control the larvae. Spraying the plants when the adults are active should give satisfactory control. See Bulletin 479.

Violet sawfly, *Ametastegia pallipes.* Leaves of pansies and violets are sometimes eaten by bluish-black, smooth larvae one-half inch long with white spots. At first the lower surface of the leaves are skeletonized. Holes are eaten later through injured foliage. Injury is most noticeable in late spring. There may be several broods during the growing season. Spraying or dusting with DDT or malathion when the larvae are first observed will protect the foliage. They may be hand-picked when occurring in small numbers.

Parsley

Leaf blight, *Septoria* spp. This disease appears as small, tan, leaf spots with black dots across the surface of the spots. These spots may grow together and kill the leaflets or leaves. The fungus which causes this disease is closely related to the fungus responsible for late blight of celery. The disease is not very important on parsley in Connecticut, and control measures are not usually required.

Aphids. Aphids may occasionally feed on parsley. See Spinach.

Celeryworm. This colorful caterpillar feeds upon parsley. See Celery.

Parsley stalk weevil, *Listronotus latiusculus.* The fat, white, legless grubs of this weevil sometimes tunnel in the main stem of parsley. Control has not been necessary.

Parsnip

Canker, *Itersonilia* sp. The diseased parsnip roots show dark, irregular, slightly-sunken pits. These cankers are usually limited to the "shoulders" of the parsnip, but may extend toward the tip of the root in case of severe infections. The disease is caused by a fungus which infects the leaves with practically no symptoms on the foliage. The spores of the fungus wash down and infect the roots, where the cankers are produced. It has been reported that spraying or dusting the foliage with inert copper fungicides will partially protect the foliage. This will in turn reduce the number of infected roots.

Aphids. The bean aphid, green peach aphid and the potato aphid all occasionally infest parsnip. Malathion will control these aphids.

Carrot rust fly. This insect injures the roots of parsnip. See Carrot.

Celeryworm. The celery caterpillar often feeds upon parsnip. See Celery.

Parsnip leaf miner, *Acidia fratria.* Parsnip leaves are sometimes mined by the larvae of this insect in May, June, and July. The larvae are greenish, about one-quarter inch in length when full grown, and they form blotch mines that are most abundant on the lower leaves. They pupate within the mines and later emerge as a pale yellow fly with green abdomen and brown curved bands on the wings. Control is not generally needed.

Parsnip webworm, *Depressaria heracliana.* When parsnip and celery are grown from seed, some injury may be caused by this caterpillar which webs together and feeds upon the unfolding blossom heads. The caterpillar is slightly more than half an inch long when full grown, greenish yellow with black head and legs, and covered with small black warts. There is one generation a year and the moths live through the winter. When nearly mature, the caterpillars leave the web and burrow inside the flower stems where they pupate. Control is not usually necessary.

Peach

Brown rot, *Monilia cinerea.* As common a disease as brown rot hardly needs description, but for the record it can be said that

Figure 98. Cankers caused by brown root organism.

on the fruit it shows as a medium-hard brown rot that spreads rapidly through the fruit. The rotted areas soon develop light gray masses of spores. These spores are readily scattered by wind and rain to cause a rapid spread of the disease under favorable weather conditions. The rotted fruits eventually dry into hard mummies which can carry the fungus over winter and produce spores in the spring. If there is warm wet weather at blossom time the spores from the mummies can cause extensive blossom infection, and from the infected blossoms the fungus grows back into the twigs causing shallow cankers which may girdle and kill the twigs. The cankers and dead twigs are a continuing source of spores throughout the summer that can at anytime cause fruit infection. As this

Figure 99. Brown rot on peach.

fungus infects the fruit largely through insect injuries, the control program should include rigid control of fruit insects such as curculio and fruit moth. Pre-blossom and even blossom sprays can be used to control blossom infection. Late sprays as near harvest as possible will prevent, to a large extent, rotting after picking.

Leaf curl, *Taphrina deformans.* With this disease the first leaves are thickened and deformed into conspicuous folds. These folds are tinted with red, pink, and yellow to the exclusion of the normal green colors. The surface has a mealy appearance due to a thick coating of spores. Occasionally infection occurs on the fruit causing a slight swelling with longitudinal cracking. The fungus overwinters on the buds, infecting the new leaves as soon as the buds begin to swell in the spring. This is the only infection period during the year so that a fungicide applied at any time when the buds are dormant will give control for the entire season.

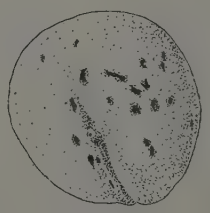

Figure 100. Bacterial leaf spot on peach.

Scab, *Cladosporium carpophyllum.* Scab shows on peaches as small circular black spots on the skin of the upper side of the fruit. In severe infections these spots coalesce with consequent cracking of the fruit. On the leaves and stems, scab shows as small red dots on the new growth which begin to show in mid-summer. The twig infections carry the fungus over winter and produce a few spores in the spring which start new infections on leaves and shoots. The fruit is infected by spores washing from the infected leaves, thus accounting for its appearance on the upper side of the peach. The usual spray schedule controls scab satisfactorily.

Bacterial leaf spot, *Xanthomonas pruni.* The bacterium causing this disease infects the leaves, fruits and twigs, producing angular water-soaked spots on the leaves, which later turn black. Even with only a few spots on the leaves they eventually turn yellow and fall. The leaf infections are most abundant along the midrib and tip because the bacteria

Figure 101. Bacterial leaf spot on peach leaf.

are washed from the twig cankers by rain and accumulate at those points. Fruit infections appear as dark angular spots on the upper side. Our observations have been that bacterial leaf spot occurs mostly on the inside leaves of young trees where the leaves dry slowly after rains. On bearing trees where the branches are spread apart and the leaves dry more quickly, little if any infection has been observed. Spraying throughout the season with a zinc-lime mixture has been found to give some control.

Yellows. This virus disease of peach is characterized by yellow-green, down-curved leaves and highly colored fruit which ripens prematurely without flavor or with a slightly bitter flavor. In later stages of the disease clusters of spindly sprouts with yellow narrow leaves appear on the trunk and main branches. The virus is not transmitted by pruning tools or other mechanical means except budding. At the moment yellows is rarely seen in Connecticut and has been scarce for the last 35 years. There is no known control except the immediate removal of infected trees. New trees can be set where infected trees have been removed with no danger of infection from the soil or roots.

Little peach. This is a virus disease, caused by a strain of the virus that causes yellows. The leaf symptoms are the same as yellows but the fruit remains small and green, ripening very late if at all. The clusters of spindle sprouts do not appear as in yellows. Transmission is by budding and by the same leafhopper that transmits yellows. But unlike yellows, it is now prevalent in Connecticut orchards and is causing an increasing amount of loss. As with yellows, diseased trees should be removed immediately to prevent spread of the disease. Experimentally we have prevented infection by soil application of calcium chloride, and in a small field trial there was evidence that this material reduced the incidence of little peach.

X disease. This is another virus disease, relatively new, discovered in Connecticut in 1933. It differs markedly from yellows and little peach in that it does not spread directly from peach to peach but is spread from chokecherry to peach.

An outstanding characteristic of X disease is the delayed appearance of foliage symptoms after growth starts following the dormancy period. The foliage of a diseased tree is normal in size and color for 7 or 8 weeks after growth starts. The flowers are normal, with no deformation or breaking of color. Suddenly, a diffused and blended yellow discoloration appears on the foliage in scattered areas over the tree or perhaps localized on a single branch. Frequently, normal leaves are interspersed between diseased leaves on the affected twigs. The chlorotic leaves often show an upward longitudinal rolling but this characteristic is by no means constant. The discolored areas at first occur in a random pattern on the leaf but ultimately the entire leaf takes on a blended red and yellow color. At this point the leaves become stiff and brittle and the discolored areas usually fall out without necrosis, giving the leaf a characteristic tattered appearance. This character is most pronounced on field grown horticultural varieties of peach and nectarine. Even on these the tattering of the leaves may not always be observed, as the leaves frequently fall off before the abscission of the chlorotic areas. A diagnostic characteristic of X disease is the retention of the tip leaves on the twigs until the end of the growing season.

Orchard trees that become infected after 3 years of age seldom die as a direct result of X disease but trees under 3 years of age are frequently killed in a short time. However, the older trees soon become unproductive, because the fruit on infected branches dries up and falls off with the dropping of the leaves. When foliage symptoms appear on a branch late in the season, the fruit does not fall but develops an insipid, slightly bitter flavor as it ripens. The seed is nearly

always abortive in such fruit. Healthy parts of an infected tree retain normal foliage and fruit throughout the season. Such healthy appearing branches are, in fact, healthy as the virus cannot be transmitted from them by budding or grafting. There is some die-back each year on infected trees, part of which can be ascribed to a direct effect of the virus and part to winter killing following a weakening of diseased branches.

X disease affects chokecherry somewhat differently from peach, although there are some symptoms common to both, notably the red and yellow coloration, delayed symptom appearance and abortive fruit. Unlike the peach, the disease has successive symptom stages on the chokecherry and usually involves the entire plant through all the stages. The first evident symptom is a slight yellowing of the foliage with faint touches of red later in the season. The second season the foliage of an infected plant shows a gradually increasing intensity of color, culminating in vivid reds and yellows during August. In the third season the foliage has an intense dark green color with a distinct rosetting at the tips of the branches. These latter symptoms may be evident in the fourth season or a dull brown-red color may be shown with distinctly dwarfed foliage. Through all these stages there is no tattering or falling of the leaves and no blotching of the color as in the peach. Such fruit as may be borne is abortive, with very little flesh and no seed in the stone. Chokecherry usually does not survive beyond the fourth year after infection.

It is possible to prevent infection of peach trees by soil applications of various chemicals, but as the virus is not transmitted from peach to peach and must always be transmitted from chokecherry, the most practical and sure method of control is the eradication of chokecherry in the vicinity of the orchard. The eradication of chokecherry for a distance of 500 feet is desirable, but if this is not practicable eradication from the fence rows immediately surrounding the orchard will give satisfactory control. By eradication we mean complete and permanent eradication of the chokecherry.

Winter and spray injuries. Low winter temperatures, especially sudden drops to below zero temperatures, will kill the fruit buds and late growing tip growth. In extreme cases the wood of the entire tree will be injured in varying degrees. Freezing injury of the wood is characterized by an abnormal darkening of the center of the branches, extending in some cases nearly to the last ring of growth. This injury to the wood is usually followed by considerable exudation of gum the following summer. Copper and arsenical sprays are sure to cause injury to peach trees, the former causing a bright red spotting of the foliage and the latter causing a necrotic spotting of the leaves followed by yellowing and dropping. Arsenicals cause twig injury as well as foliage injury. Other materials may cause various types of injuries to peach trees but lack of space and knowledge of characteristic symptoms precludes particular descriptions.

Aphids. Several species of aphids occur on peach trees. Some of the more important ones are as follows: The black peach aphid, *Aphis persicae-niger,* lives through the winter on the roots, and migrates to the leaves and tender shoots in spring; the black cherry aphid, *Myzus cerasi;* the green peach aphid, *Myzus persicae;* and the rust plum aphid, *Hysteroneura setariae.* The common treatment is to spray with malathion or nicotine and soap.

European fruit lecanium, *Lecanium corni.* These are convex scales considerably larger than San Jose or Forbes scale. They are rare in Connecticut and control is not usually required. See Bulletin 575.

European red mite, *Metatetranychus ulmi* (Koch). This mite attacks peaches as well as apples. See Apple.

Forbes scale, *Aspidiotus forbesi* Johns. The scale differs from San Jose scale in having the center orange red instead of yellow. Life history, damage, and controls are essentially the same as for San Jose scale.

Lesser peach tree borer, *Synanthedon pictipes.* The habits, appearance and control of this pest are very similar to the peach tree borer below. See Bulletin 575.

Oriental fruit moth, *Grapholitha molesta.* This is the most destructive insect pest of peach and quince in Connecticut. The larvae tunnel in the tender shoots of peach early in the season, and later leave the twigs and enter the fruit. Those hatching late in the season go directly into the fruit. This insect is the cause of most of the wormy peaches, and there are three broods and sometimes a

Figure 102. Oriental fruit moth.

partial fourth brood in Connecticut. The mature larva is pink and about half an inch in length. As a twig borer, it kills the tip and causes the shoot to branch. The insect hibernates as a mature larva in an impervious silk case on the bark of the trunk or upon rubbish. It pupates in the case and the moth that emerges has a wing spread of half an inch or less, and is gray in color with chocolate brown markings. The females lay eggs upon the under sides of the leaves and, in some cases, on the twigs. (See figure 102.)

Injury is worse on trees that have made a rank growth and this condition should be avoided as much as possible. Orchard and packing house sanitation should be practised. Keeping the trees sprayed with DDT or methoxychlor from the time the shucks are splitting until four weeks before harvest has controlled this pest. See Bulletin 575.

Peach tree borer, *Sanninoidea exitiosa.* This is one of the major insect pests of peach. The larvae tunnel in the wood just beneath the bark on the trunks of the trees. Masses of semi-transparent peach gum exude from the wound and the borer may pupate in the gum. The empty pupa case often protrudes from the mass of gum after the emergence of the adult moth. The moths emerge in July and August and are wasp-like clear-wings with a wingspread of about one inch. The mature larva is about an inch long and light yellow in color with dark brown head. There is one generation annually. (See figure 103.) Specially formulated sprays for control of this pest are on the market. See Bulletin 575.

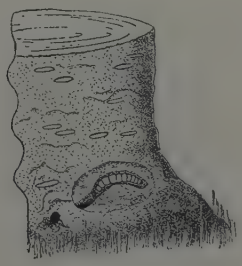

Figure 103. Peach tree borer.

Peach twig borer, *Anarsia lineatella.* The larva of this insect is a borer in the twigs and also occasionally enters the fruit, but it can be distinguished from that of the Oriental fruit moth by its reddish brown color. The larva is less than half an inch long when mature and constructs a loose cocoon under the curled edge of the bark. Ten to twelve days later the steel gray moth emerges. It has a wing spread of about half an inch. There are four broods each season. The presence of the larva in the twig is indicated by the reddish brown masses of chewed bark webbed together in the crotch. No control is needed as a rule.

Plant bugs, *Lygus oblineatus* and *L. caryae.* These and other species of plant bugs damage, puncture, and feed on young fruit. They are brown in color and about one-fourth of an inch long. The feeding punctures cause distortion of the fruit. The bugs hibernate over the winter. Spraying with DDT when petals fall and again when shucks split has controlled plant bugs.

Plum curculio. This is an important pest of peaches. See Plum. Spraying with methoxychlor at 7 to 10-day intervals for a month, starting when the shucks split from the fruit, has given good control in our tests.

Plum leafhopper, *Macropsis trimaculata.* This leafhopper is rare in Connecticut, but is important because it transmits virus diseases.

Rose chafer. This general pest also feeds on peach. See Rose.

San Jose scale. This scale often infests peach trees and has caused severe injury. See Apple.

Shot-hole borer, *Scolytus rugulosus.* This little dark brown beetle breeds under the bark of fruit trees including peach, and emerges through small circular holes resembling shot holes. The larval galleries nearly or quite girdle the stem or branch, and on stone fruits gum exudes from the exit

holes. The adult beetle is about one-tenth of an inch in length, is dark brown and emerges in early spring. There are probably two generations each year in the northern states, and this pest generally breeds in injured or weakened trees. Consequently, it is advisable to keep the trees as vigorous as possible. Some protection against this insect is afforded by spraying the bark with DDT. (See figure 104.)

Figure 104. Work of shot-hole borer.

Two-spotted mite. This mite also damages peach. See Apple.

Pear

Fire blight, *Erwinia amylovora.* The symptoms of fire blight on pear are the same as on apple. See Apple. On pear the disease is much more severe, even to the point of killing the tree. Trees in a vigorous growing condition are more susceptible than trees making moderate growth, thus pears should not be heavily fertilized. Recent work with antibiotics has shown that properly timed sprays will give satisfactory control of fire blight.

Leaf spot, *Fabraea maculatum.* Not an important disease on pears in Connecticut. See Quince, black spot.

Scab, *Venturia inaequalis.* Varieties commonly grown commercially are scab resistant and special control measures are not necessary. See Apple for description.

Sooty blotch, *Gloeodes pomigena.* With present spray practices this is not an important disease and requires no special treatment. See Apple for description.

Cherry or pear slug. This insect often defoliates young pear trees. See Cherry.

Codling moth. The codling moth also injures the fruit of pear, especially late varieties harvested after the middle of August. Sprays of DDT applied late in July have controlled it.

Fall webworm, *Hyphantria cunea.* White webs or nests are formed by this insect on the ends of the branches of fruit, shade, and woodland trees during the latter half of summer. There is one complete annual generation and a partial second in Connecticut. The eggs are laid in white masses containing 400 to 500 eggs, on the underside of the leaves. They hatch in 10 days and the larvae from each egg-mass live together as a colony. They spin webs enclosing the leaves, usually at the end of a branch, and feed inside the nest. When the food has been exhausted, they extend the nest to include additional foliage. When nearly full grown, they leave the nest and crawl about seeking a place to transform and finally make their gray cocoons on the under side of rubbish, fences, crevices in the bark, and other protected places, where they hibernate.

The fully grown caterpillar is about one and one-fourth inches in length with a broad dark brown stripe along the back, and yellowish sides thickly peppered with small blackish dots. Each segment is crossed by a row of tubercles bearing rather long light brown hairs. The moths have a wing spread of about 1¼ inches, and vary from pure satiny white to white thickly spotted with small dark brown dots. Control measures consist of cutting off and burning the nests when first formed, and spraying the trees with DDT. (See figure 105.)

Figure 105. Nest of fall webworm.

False tarnished plant bug, *Lygus invitus.* This bug causes serious injury in pear orchards by puncturing the growing fruit, which becomes knotty, deformed, and gritty in texture. The adult resembles the tarnished plant bug though a trifle smaller and paler. The winter is passed by the egg stage in the bark, and the eggs hatch at blossoming time. The nymphs pass through five immature stages and after the first are conspicuously green. They begin to puncture the fruit as soon as it sets. They become mature about the middle of June. Control measures consist of the use of nicotine sulfate in sprays applied immediately after the blossoms fall, and repeated a week later.

New York weevil, *Ithycerus noveboracensis.* The adult beetles sometimes cause severe injury to young pear trees by eating off the leaf buds in early spring. They may also eat the bark of the new growth, and cut off the leaf stalks and new shoots. They feed chiefly at night. This beetle is ash-gray in color with darker spots, and is about five-eighths of an inch in length. The only known means of control is by hand picking and by jarring the insects onto sheets placed under the trees.

Pear leaf blister mite, *Eriophyes pyri.* The unfolding leaves of pear and apple are often disfigured by greenish yellow or reddish blisters that later turn brown. In severe cases the leaves may drop in mid-summer. There are colonies of microscopic mites living within the tissues of the leaf. They pass the winter beneath the bud scales. The control is to apply a dormant spray of lime sulfur or oil just before the buds open in spring.

Pear midge, *Contarinia pyrivora.* In June the small pears often drop in great numbers, and some of them are split open. When examined they are found to be infested with maggots. A small midge resembling a mosquito lays eggs in the blossoms and on hatching the maggots work their way down into the core. They gradually hollow out a large cavity that may occupy the entire interior of the young fruit. The maggots reach maturity in June; the fruit usually cracks open and falls to the ground; and the larvae enter the soil, where they pupate and hibernate. Applications of nicotine sulfate or malathion when the buds show pink will kill the adults.

Pear plant bug, *Neolygus communis.* The feeding punctures of these bugs deform young pears seriously. The young bugs are pale yellow or green, and the adults are brown. Adults hibernate over the winter and attack pears at the time the petals fall from the blossoms. The adults leave pears late in June. Two sprays of malathion, the first as soon as petals fall and the second about a week later, have controlled these bugs.

Pear psylla, *Psylla pyricola.* This is one of the more serious pests of pear, and there are at least four broods each season. The adults hibernate under the edges of the rough bark of the trunk and branches, emerge during the first warm days in April, and soon deposit eggs in old leaf scars, in cracks and crevices, and around the base of the terminal buds. Most of these eggs are laid before the buds open, and nearly all have hatched by the time the petals fall. The nymphs go to the axils of the leaf petioles and begin to suck the sap. Much of the sap is excreted as honey-dew which drips upon the lower leaves and in it a sooty fungus grows. About a month is required for the complete life cycle and by midsummer a badly infested tree is blackened throughout on leaves and fruit. Some of the leaves will fall before the fruit ripens. The adult is about one-tenth of an inch long and resembles a tiny cicada. Repeated applications of malathion have killed nymphs and adults in summer. A dormant oil spray applied late in the winter before eggs are laid is helpful.

Pear thrips, *Taeniothrips inconsequens.* The pear thrips causes injury to the blossoms of the pear and some other fruit. The black adults emerge from the ground about April 1, work their way into the swelling buds, and soon lay eggs in the stems and midveins of the unopened bud. The eggs hatch in 2 weeks and large numbers of the white nymphs feed upon the unfolding buds. Heavily infested orchards appear as if a fire had scorched the trees, and the blossoms are destroyed. The best treatment is to spray soon after the adults first appear in early spring, using DDT. In heavily infested orchards, this application should be repeated at the cluster-bud stage.

Pears injured by squirrels. Pears are often cut from the trees by squirrels in August. The fruit drops to the ground and

though not ripe, the squirrels bite into it and eat the seeds. Sometimes the entire crop is ruined in this manner. There is no control by spraying.

Quince curculio, *Conotrachelus crataegi*. This insect injures pears in a manner different from that usual in quince. In pear, a cavity between the skin and the core contains the larva. On the outside there is a flattened hardened area with a puncture in the center, but the fruit is not especially knotty or deformed A spray of DDT should be applied soon after the beetles appear about the first week in July. For life history, see Quince.

Figure 106. San Jose scale.

San Jose scale. This is a small circular dark gray scale that infests the bark of nearly all kinds of fruit trees and many other kinds of trees and shrubs. It hibernates in a half-grown state and there are three broods each season. The largest scales are the females, which are about one-sixteenth of an inch in diameter, and circular with a raised center or nipple. The males are smaller and elongated, with the nipple not in the center. This scale does not produce eggs, but gives birth to living young which crawl about for a few hours, then settle upon the bark. (See figure 106.) The usual control treatment is to spray the dormant trees in spring. See Apple.

Scurfy scale, *Chionaspis furfura*. This is a whitish or light gray scale that infests pear, apple, currant and some other trees and shrubs. The female is pear-shaped and about one-tenth of an inch in length, and the insect passes the winter in the form of purplish eggs under the parent shell. The male is much smaller, long and narrow, with three longitudinal ridges or carinae. The eggs hatch in Connecticut about the last week of May and the yellow crawlers may be seen

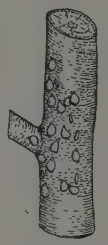

Figure 107. Scurfy scale.

on the bark. They soon establish themselves and begin to suck the sap. (See figure 107.) A spray of nicotine sulfate and soap early in June will readily destroy the young. Dormant treatments with lime sulfur or miscible oil are also effective in holding this insect in check.

Sinuate pear borer, *Agrilus sinuatus*. The grub or larva of this Buprestid beetle tunnels in the branches causing ugly scars and some breakage. The adult is a slender glossy bronze-brown beetle one-third of an inch long, and the females lay eggs in the crevices and under the edges of the bark during June. In early July the eggs hatch and the young grubs excavate narrow sinuous tunnels in the sapwood just beneath the bark. They become partly grown when winter arrives, hibernate in the burrows, and continue their destructive work the following season. The galleries are then larger and their course shows through the bark. By the second September the grubs are about 1½ inches in length. They tunnel deeper into the wood and excavate the pupal chambers which are connected by exit holes with the bark. Here they hibernate. The following April they pupate and the beetles emerge a month later. Two years are required for the complete life cycle.

Severely injured branches should be cut off and burned, and the trees fertilized and kept in a vigorous condition. Spraying the foliage in late May and June will kill some of the beetles that feed upon the leaves. Probably sprays of lead arsenate applied to the bark may act in some measure as a deterrent.

Peas

Blight, *Ascochyta pisi*. This fungus disease is most prominent on the pods where

it shows as dark or tan, sunken, circular pits. Small, black dots are scattered across the surface of spots. These spots may also be found on the leaves and stems. They are more purple on the stems. If young plants are attacked, they may be killed. The blight fungus is favored by cool, wet weather. The fungus survives in seed, old pea vines, and in the soil. To avoid the disease, use clean seed, plant on well-drained soil, remove and burn old pea vines, and practice crop rotation.

Root rot. Various common soil fungi. When the weather gets warm, pea plants with root rot appear yellow, spindly, and stunted. The stem near the ground is withered. The inside of the stem is not discolored. The disease is caused by a number of fungi which live in the soil and rot the roots and lower part of the stem during periods of very cool wet weather. To avoid this disease plant peas as early as possible, in hilled-up rows on well-drained soil. Practice crop rotation.

Fusarium wilt, *Fusarium* spp. The symptoms of wilt plants are very much like those of peas with root rot. The main differences are that the base of the stem of a wilt plant is not withered, and the inside of the stem shows discoloration. Control measures are the same as for root rot.

Mosaic. Pea plants with mosaic are usually stunted, have light-colored mottled leaves, and set few and poor pods. Mosaic is caused by a virus which is carried by aphids. The virus also attacks clover. To keep down mosaic, avoid planting peas near clover, remove pea plants which show leaf mottle, and control aphids.

Green cloverworm. This caterpillar also feeds upon pea foliage. See Bean.

Pea aphid, *Macrosiphum pisi.* This is a green, long-legged aphid with prominent red eyes. It may infest the leaves and stems of peas in June. Pea aphids suck the sap and may stunt the crop, but have not been a serious pest, however. They can be controlled with malathion. See Alfalfa.

Pea weevil, *Bruchus pisorum.* The adult of this insect is a brownish beetle, spotted with gray, dark brown and white, and measuring about one-fifth of an inch in length. These beetles appear in the field about the time the peas are in blossom, and after light feeding on the foliage, the females lay their eggs on the surface of the newly-formed pods. In about 12 days the egg hatch and the young larvae or grubs drill into the pods and work their way into the peas where they feed until fully grown. They pupate, and often remain in the seeds until the following spring. There is only one generation each year, and this weevil does not breed in the dried seeds as does the bean weevil. The weevils in the seeds can be killed by fumigating in a tight box for 36 hours at a temperature of 70° F., or higher, using 1 pound of carbon disulfide for each 100 cubic feet. The fumigation must be done in a building where no sparks will ignite the inflammable gas.

Peony

Grey mold blight, *Botrytis paeoniae.* This fungus attacks young stems, leaves, and buds, causing a brownish-black rot covered with grey mold. Rot may extend several inches below the bud. Half open flowers turn brown in part or entirely. The fungus usually fruits readily on infected parts. Small black sclerotia may be formed on the bases of the stalks and other affected parts that fall to the ground.

Prompt removal of infected plant parts lowers the possibility of new infections. Good sanitation includes cutting and burning all old stalks in the fall and removal of mulch early in spring. Sometimes removal of the top 2 inches of soil, replacing with new soil, is helpful in stubborn cases. Bichloride of mercury 1:2000 (see p. 78) sprinkled on the soil around plants may stop the disease.

Figure 108. Botrytis blight on peony bud.

Stem rot, *Sclerotinia sclerotiorium.* Symptoms are similar to those of *Botrytis* blight but sclerotia are large and black and are found in the center of diseased stems. Control is the same as for grey mold blight.

Lemoine's disease. Cause unknown. Spindling shoots and dwarfed plants which never bloom characterize this trouble. Roots are elongated and irregularly swollen with few feeding roots No cure or control is known.

Bud blast. Cause unknown. Buds remain small and turn black but no grey mold appears on them. Cause is unknown but it has been suggested that it may be potash deficiency or late spring frosts.

Root knot nematodes, *Meloidogyne spp.* Plants are small and weak and produce no flowers. Roots are short and stubby, and fine roots show galls about one-eighth inch in diameter. When sliced, these reveal brown areas containing many eelworms.

Hot-water treatment at 115° F. for one-half hour of roots and crown effectively kills nematodes. Planting treated roots in a new location prevents reinfestation. Since many other species of plants may become infested with these eelworms, soil sterilization (see p. 4) is necessary.

Leaf blotch, *Cladosporium paeoniae.* After blooming, purple blotches may appear on the leaves which in wet weather are covered with an olive-grey mold. Destruction of old plant parts in the fall is usually sufficient for control.

Leaf spots, *Septoria paeoniae, Pestalozzia* sp., *Alternaria* sp., *Phyllosticta* sp. These leaf spots usually appear on mature leaves and may be controlled by removal and burning of old leaves in the fall.

Ants. The presence of ants on peony buds does not indicate injury to the plant by the insects. They are feeding on the sweet secretion produced by the buds.

Rose chafer. The beetles feed upon and soil nearly all the white flowers. See Rose.

Peperomia

Corky scab. Raised scab-like swellings appear on underside of leaves. Since this trouble occurs after overwatering during cloudy weather, withholding water may prove helpful.

Pepper

Mosaic diseases. Pepper plants with mosaic have mottled leaves and small, bumpy, off-color fruit. The diseased plants are usually stunted and have smaller leaves than normal. The symptoms on the fruit may include light-colored ring-spots or target spots. Mosaic on pepper may be caused by a number of different viruses alone or together. These viruses also infect tobacco, tomato, cucumber family crops, alfalfa, clover, and many other crops and weeds. Most of these viruses are carried by aphids. Some of the viruses may last in crop refuse for a long time, and may sometimes be carried by merely touching a healthy plant after touching a diseased plant. Other viruses attacking peppers do not last very long in crop refuse and are carried only by insects.

To avoid mosaic on pepper control insects; do not plant next to tomatoes, cucumbers, tobacco, alfalfa or clover; and pull up and destroy plants showing symptoms.

Anthracnose, *Colletotrichum nigrum.* On either green or ripe pepper fruits, this disease shows as dark, circular, sunken spots which vary in size, but may be an inch or more in diameter. The surface of the spots is covered with black dots which contain the spores of the fungus. After rain or heavy dew, pinkish masses of spores exude from these dots. Infected fruits may be completely rotted away and fall from the plants. They may also cling to the plants in as withered "mummies." Diseased fruits serve as sources of spores which wash and splash around to infect other fruits. Anthracnose is a soil and seed carried disease which also infects and survives on stems and leaves through the season. On stems and leaves the symptoms are usually so slight that the plant does not appear diseased until fruits develop. To control this disease use clean seed and practice crop rotation. It is usually not important enough in Connecticut to require spraying.

Damping-off, *Pythium debaryanum, Rhizoctonia solani, Sclerotinia sclerotiorum.* This disease is a rotting of the roots and the base of the stem so that the seedling falls over and dies. Damping-off is caused by a number of different fungi which live in the soil and may attack seedlings of almost any crop. Pepper seedlings are particularly susceptible to damping-off.

The disease is favored by high soil moisture and cool temperatures. To avoid damping-off, start seedlings in pasteurized soil, give them only enough water to keep the plants growing normally, and ventilate the

growing space during the day. If damping-off should begin, the soil in which the seedlings are growing may be watered with oxyquinoline sulfate or ferbam. Once plants are beyond the seedling stage they are not susceptible to damping-off.

Aphids. Pepper plants are occasionally infested by at least three different species of aphids: the melon aphid, *Aphis gossypii,* green peach aphid, *Myzus persicae,* and the potato aphid, *Macrosiphum solanifolii.* The remedy is to treat with malathion.

European corn borer. These caterpillars may feed on the fruit, particularly if corn and pepper are planted adjacent to each other. See Corn.

Flea beetle. This small, black, active beetle may feed on newly set plants early in the season. DDT, methoxychlor, rotenone, or pyrethrum may be used for their control.

Pepper maggot, *Zonosemata electa.* The maggots of these barred-wing flies infest the fruits of peppers, causing them to decay. The eggs are deposited in July and August in the wall of the fruit and often project into the interior cavity. They hatch in 10 days and feed inside the core until mature, a period varying from 12 to 22 days. They then make an exit, usually near the stem, and go into the ground and pupate 1 or 2 inches beneath the surface. There is one generation a year. The adult is a two-winged fly, light yellowish-brown in color, with three brown bands across each wing. They do not usually require control in Connecticut.

Stalk borer. These dirty grayish caterpillars, which are darker with white stripes when young, also bore in the stems of pepper. Control by dusting and spraying the stems and soil near the base of the plants with methoxychlor.

Periwinkle (Myrtle)

Wilt, *Phoma* sp. Tips wilt and turn black, showing grey lesions with tiny black pustules in the center. Destruction of all infested plant parts together with sprays of dichlone, ferbam, or thiram gives satisfactory control.

Petunia

Mosaic and other viruses. Petunia is susceptible to several of the viruses found on tomatoes and potatoes. Light and dark green mottled areas and crinkling of leaves indicate infection by the tobacco mosaic virus. Other viruses may produce dwarfed cupped leaves and witches'-broom effects.

Since tobacco mosaic virus is spread by mechanical contact, most infection can be prevented by avoiding touching good plants after handling infected plants unless the hands are thoroughly washed with soap and water first. Roguing infected plants and placing petunias at some distance from other solanaceous plants such as tomato, flowering tobacco, potatoes, eggplant, and peppers reduce the chances of infection. Control of insects to keep them from moving from plant to plant will prevent their spreading these diseases.

Greenhouse orthezia. This greenhouse insect often infests bedding plants out of doors, including petunia. See Lantana.

Potato flea beetle. This tiny black flea beetle feeds upon a great variety of plants, of which one is petunia. See Potato.

Yellow woolly bear. The yellow hairy caterpillars feed upon petunia and a great many other kinds of plants in the garden. See Verbena.

Philodendron

Root rot, *Rhizoctonia* sp. Leaves turn yellow from the bottom of the plant up, and drop. Since this same effect can be caused by too much fertilizer, laboratory examination is necessary to determine the cause. Soil applications of oxyquinoline sulfate 1:4000 (see p. 5) gives good control of *Rhizoctonia.* In the case of excessively high fertilizer, repotting in soil that is less rich is indicated.

Phlox

Powdery mildew, *Erysiphe cichoracearum.* Phlox are very susceptible to this fungus which appears as white mealy growth on both surfaces of leaves and stems. Regular sprays or dusts of sulfur beginning in early June give good control. Use of resistant varieties is helpful.

Leaf spot, *Septoria divaricata.* Infection is usually noticed when lower leaves curl and dry up, but the first signs are actually dark brown spots with grey centers. Removal and burning old stalks and leaves in the fall will prevent much of this trouble, but sprays of zineb, ferbam, thiram, or Bordeaux ap-

plied as soon as noticed will keep the trouble pretty well under control.

Stem nematodes, *Ditylenchus dipsaci.* Plants are stunted, with swollen or cracked stems and deformed thread-like or curled leaves. No flowers are produced, and plants die prematurely. The nematodes which cause this trouble are systemic and come from infested plants or soil and can be carried by water, garden tools, feet of animals, or in the seed. Prompt roguing followed by soil sterilization (see p. 4) is indicated.

Leaf blight. Non-parasitic. Lower leaves shrivel, and plants may yellow and die. This trouble is associated with old clumps, never on seedlings, and appears to be the result of a physiological disturbance. Cuttings taken from these clumps are not affected nor is new growth arising from the crown or from the base of old stems.

Phlox plant bug, *Lopidea davisi.* This bug injures phlox by puncturing the tender shoot or leaves at the growing tip and sucking the sap. It appears to be of minor importance in Connecticut. Should they become abundant, the bugs may be killed by spraying with malathion or nicotine sulfate and soap.

Two-spotted spider mite, *Tetranychus bimaculatus.* This is the most serious of all pests of phlox. It infests the undersides of the leaves, which become light yellow in color, and the plants have a generally unthrifty appearance. Sometimes the spiders, their eggs and eggshells, more or less inclosed in webs, are formed on the upper as well as on the under leaf surface. Spraying with malathion or aramite will give good control. The treatment should be directed mainly to the underside of the foliage. Several treatments at 5- to 7-day intervals may be necessary when an infestation is serious.

Stalk borer. This borer occasionally tunnels in the stems of phlox. See Dahlia.

Pine

Dieback, *Diplodia pinea.* Tip growth on two- and three-needle pines is stunted for several years, and branches usually die back. The needles are short and turn brown prematurely, usually showing the small black fruiting pustules at or below the sheath. Control may be obtained by spraying new growth when half grown and again when full grown with Bordeaux, plus spreader. Dichlone may be tried on an experimental basis. Pruning of infected twigs removes the source of future infection.

Figure 109. Dieback of pine.

Needle cast, *Lophodermium pinastri.* Several fungi may cause needle cast of pines in nurseries and reforestation areas and occasionally in ornamental plantings. *L. pinastri* infection first becomes evident as a reddening of needles in late fall. In the spring dead spots appear, and needles die from the tips toward the base. Tiny black linear fruiting bodies form in the spring and early summer, and the needles eventually drop. Symptoms on two-, three-, and five-needle pines are more or less the same. Control of this and other needle cast diseases is obtained with sprays of Bordeaux plus a sticker-spreader when new growth is half grown and again when full grown.

Figure 110. Needle rust of pine.

Needle rust, (Pine-goldenrod) *Coleosporium solidaginis.* This rust is typical of many similar needle rusts on two- and three-

needle pines. It is common on pitch, red, and jack pine. In spring small white tubes which discharge orange spores appear on the needles. These spores infect the alternate hosts, chiefly aster and goldenrod, where the fungus can maintain itself indefinitely. This trouble usually is of little importance on old trees but can weaken young stock considerably. Elimination of the alternate hosts within 1000 feet may be helpful.

Damping-off, *Rhizoctonia solani.* Seedlings turn brown and dry up. Fine roots are rotted and lesions found on larger ones. Sand or soil may cling to roots. Microscopic examination will determine if this fungus is the damping-off agent. Good control of *Rhizoctonia* may be obtained with two or three soil applications of oxyquinoline sulfate 1:4000 (see p. 5) a week to 10 days apart.

Needle blight. Cause unknown. This trouble is characteristic of white pines. Needles turn reddish-brown more or less at the tips and give the tree a scorched appearance. No fungus has been found associated with this trouble, but wind and sun appear to be partially responsible for the burning. Some trees seem to blight every year; others occasionally.

White-pine blister rust, *Cronartium ribicola.* Although this disease usually passes unnoticed until the second or third year after infection, the fungus enters young needles in the fall and works its way down the needle into the wood. The infected wood swells and has a yellow or orange tinge. In spring or early summer drops of clear orange liquid appear on infected areas which attract insects; these pycnia later fall out leaving dark scars. The following year white blisters push through the bark. These discharge orange aeciospores that are carried by wind to infect currant, gooseberry and wild *Ribes* leaves, where the spores that infect the pine needles are produced. The part of the tree beyond the canker dies if the canker extends around the trunk. Control has been successful where all *Ribes* within 900 feet of white pines have been removed. The European black currant and gooseberry are more susceptible than the ordinary red currant which may be planted not closer than 400 feet from white pine. The European black currant may not be planted in Connecticut.

Sooty mold, *Dimerosporium* spp. Needles and bark of certain branches appear black. Sometimes one whole side of a tree is affected. The fungus is entirely superficial and grows on honeydew left by aphids or some scale insects. There is no real injury to the tree. The remedy consists of controlling the insects.

Aphids. There are several aphids on the branches of various species of pine. Any of these aphids can be controlled by spraying with malathion or nicotine sulfate and soap.

Figure 111. European pine shoot moth.

European pine shoot moth, *Rhyacionia buoliana.* This insect is a serious pest of red and Scotch pine and it is known to infest other pines. The larva feeds upon the buds and tunnels in the new shoots. Terminal buds are killed and lateral shoots become leaders. It also feeds on the outside of the new shoots and this makes them crooked near the tips, a condition called "bayonet growth." The larva hibernates in the buds and pupates in its burrow about June 1. The moth emerges the latter part of June and has a wing spread of about two-thirds of an inch. The forewings are reddish brown, crossed by two whitish bands near the tips. The eggs are laid on the twigs near the terminal buds. The larva is brown with black head and reaches a length of about five-eighths of an inch when mature. There is one generation each year. (See figure 111)

Some degree of control may be obtained by cutting off and burning the infested tips in late winter. A spray of DDT heavy enough to run down and accumulate at the base of the needles, applied July 1 and again 10 days later will control the pest on shade trees.

Pales weevil, *Hylobius pales.* This weevil or snout beetle has the reputation of gnawing the bark from the trunk and twigs of young seedling pines and from the lower branches of older trees where they are near the ground. There is probably more danger of injury to young trees by this insect if they are planted where pine trees have recently been cut.

It is safer to burn the slash and wait 2 years before planting young trees on such land. Thinning of pine stands rather than clean cutting may reduce the hazard of damage. Freshly sawed pine lumber should not be stored near young pine stands because it attracts weevils which later damage living trees. Small plantings of young pine can be protected by dusting the base of the trees with dieldrin or DDT in the spring.

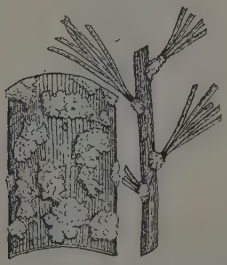

Figure 112. Pine bark aphid.

Pine bark aphid, *Pineus strobi.* This is a woolly aphid that infests white pine. Small masses of wax secretion at the base of the leaf clusters contain the eggs which carry the insect through the winter. In summer white flocculent patches appear on the trunks, base, and undersides of the larger branches. These are colonies of brown aphids covered with wax secretion and in some instances are so abundant as to reduce the vitality of the trees. There are several generations each season. (See figure 112.) Spraying with malathion or nicotine sulfate and soap early in May has controlled crawlers of the first brood. A later treatment may be necessary if the infestation persists. See Bulletin 588.

Pine bark beetles. There are several small bark beetles that commonly breed in the living bark of stumps, injured, or dying pine trees. Some of the more important species are the black turpentine beetle, the red turpentine beetle, the coarse writing bark beetle, and the pine bark beetle. Keeping living trees in good condition and prompt destruction of infested pines should reduce damage by this pest. Spraying the bark of trees with DDT will kill the adults when they are active.

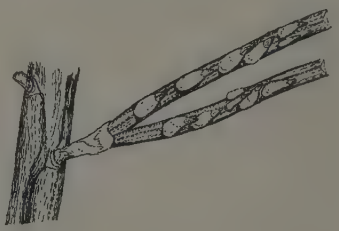

Figure 113. Pine leaf scale.

Pine needle scale, *Phenacaspis pinifoliae.* This is a white pear-shaped scale that infests the leaves of various species and varieties of pine, including white, red, Scotch, Austrian, and mugho pines growing in sheltered places. There are two generations each season and the insect hibernates in the form of eggs underneath the old shells. The eggs hatch the latter half of May; the young crawl about for a few hours then settle down, begin feeding, and secrete the wax that forms the shells. Early in July the first brood matures and eggs for the second brood are formed under the shells. These hatch later in July and August and the second brood matures and forms eggs the first half of October. (See figure 113.) Spraying with malathion about June 1 and again August 25 should control the young crawlers. See Bulletin 578.

Pine webworms, *Tetralopha robustella* and *T. melanugrammos.* Seedlings of red pine and white pine are sometimes infested with caterpillars that web together the leaves and frass, live in tubes within the mass, and feed upon the leaves. Some of these frass balls are globular and 2 inches or less in diameter, other are more elongate. Little is known of the life histories. Spraying with DDT or lead arsenate in July and again in August will probably protect the foliage.

Pine sawflies. There are several species of pine-feeding sawflies in Connecticut and the larvae devour the needles, sometimes defoliating the trees. Some of these are as follows: The introduced pine sawfly, *Diprion simile,* has brown- and green-striped and mottled larvae; the white-pine sawfly, *Neodiprion pinetum,* has whitish larvae with black spots and black head; the red-headed pine sawfly, *Neodiprion lecontei,* has yellow larvae with black spots and red head, that feed upon white, red, and mugho pines; another species feeds upon the pitch pine; a larger species webs together the needles and its frass to make a nest in which it lives and feeds on Austrian pine. (See figure 114.) In case of injury by any of these sawflies, spraying the leaves with DDT or lead arsenate as needed will prevent defoliation.

Figure 114. Abbot's pine sawfly.

Pine spittlebug, *Aphrophora parallela.* The immature stages of this insect develop in a froth mass or "spittle ball" on the twigs of different species of pine. These froth masses are from one-half to three-fourths of an inch in diameter and are usually near the tips of the twigs. The adult is gray-brown about one-half an inch long. Little is known about prevention or control. See Meadow.

Pine tube moth, *Argyrotaenia pinatubana.* The larva of this moth webs the pine needles together to form a tube or case in which it lives and devours the terminal third of the leaves. The larva is pale green with light brown head, and is about one-third of an inch in length. The moth has a wing spread of slightly more than half an inch, and the forewings are rust-red, crossed by two oblique parallel paler bands. The tube usually contains about 15 needles fastened together with silk threads. There is probably one brood each year. Though not of great economic importance, if the pine tube moth should become abundant, a spray of DDT or lead arsenate will control it.

White grubs. In forest nurseries the roots of pine seedlings and transplants are sometimes eaten by white grubs. See Meadow.

White-pine weevil, *Pissodes strobi.* This is the insect that kills the leaders of white pine, and is perhaps the most serious pest of white pine at the present time. The adult beetles hibernate under dead bark, stones and wherever they may find protection in woodland areas, and appear on the trees in April. During May they ley eggs in punctures in the bark of the leaders and the grubs feed under the bark, often girdling them so they wilt and die in July. The grubs are then mature and make cells in the wood of the leader and pupate therein. The beetles begin to emerge the latter part of July and continue into September. They go early into winter quarters. There is one generation each year. The adult is a reddish-brown beetle with white spots, and about one-fourth of an inch or slightly more in length. Seedlings planted in shade are seldom injured, but those in sunny situations are infested. Pines in mixed stands also escape serious damage.

Jarring the trees twice a week from May 1 to June 15 and catching the beetles in a net is one method of control. In forest plantations the practice of cutting and burning the weeviled leaders during the first half of July has given fairly satisfactory results. Spraying with DDT or lead arsenate in the fall before the beetles hibernate, or in the spring before eggs are laid, may kill the feeding weevils.

Matsucoccus scales, *Matsucoccus* sp. Two species of this genus occur on pines in Connecticut. *M. gallicolus* attacks pitch pine and *M. resinosae* is very destructive to red pine in the eastern part of Fairfield County. These scales live on the bark, and are very inconspicuous until trees are heavily infested. The red pine species has two generations a year and overwinters as a partly grown larva. Severe infestations cause the needles to turn yellow, and cottony masses appear on the undersides of branches, especially at branch axils.

Control by use of insecticides has not been successful. Young plantations of red pine may be re-planted with white pine, and older trees harvested for pulpwood. This pest and the pine shoot moth make growing of red pine very difficult in Fairfield County.

Plum

Black knot, *Dibotryon morbosum.* The conspicuous black elongated galls on the twigs and branches are the distinguishing symptoms of this disease. The color is due to a layer of black embedded spore bearing receptacles on the surface of the gall. Spores from these receptacles are washed onto the new twig growth early in the season, causing new infections which will not be apparent for 1 or 2 years. The disease is not harmful to the tree until the gall completely encircles the branch, with consequent girdling and death of the branch beyond the gall. Some of our early work on the control of black knot showed that liquid lime sulfur prevented the production of spores on the galls but it was not definitely shown that control resulted. More recent work elsewhere has shown that liquid lime sulfur sprays at the dormant, full bloom and shuck fall gave satisfactory control. On a few trees it is probably more satisfactory to cut off and burn the knots, making sure to cut several inches back of the knot to insure against leaving any infected tissue.

Brown rot, *Monilia cinerea.* This is the same disease as on peach. Blossom infection is much less important on plum than on peach. See Peach.

Leaf spot, Anthracnose, *Coccomyces hiemalis.* Usually not as serious on plums as on cherry. See Cherry.

Bacterial spot, *Xanthomonas pruni.* This disease is caused by the same organism that attacks peach but the symptoms are somewhat different. On the leaves the infected areas soon fall out giving a pronounced shot-hole effect. On the fruit infection shows as purplish-black, sunken spots on the green fruit which are more conspicuous than on peach. See Peach.

Plum pockets, *Taphrina pruni.* Plum pockets are somewhat rare in Connecticut but because of the unique fruit deformation are very conspicuous. The fungus causes the green fruit to become greatly enlarged into irregular hollow pouches. Scarcity of disease makes control measures unnecessary.

Yellows and little peach. The Japanese plums are symptomless carriers of peach yellows and little peach and as such can be a source of infection to peaches although the plums show no apparent effect.

Aphids. Several species of aphids sometimes infest plum trees. Some of these are the green apple aphid, *Aphis pomi;* the green peach aphid, *Myzus persicae;* the mealy plum aphid, *Hyalopterus arundinis;* the rusty plum aphid, *Hysteroneura setariae.* Outbreaks of these aphids on plum can be controlled by spraying thoroughly with nicotine sulfate and soap, or malathion.

Apple maggot. This pest is occasionally found in plums, Italian, or German prunes. Control is difficult because of residue problems, but is usually not needed. Control of the pest on nearby apples may be the best solution. See Apple.

Figure 115. European fruit lecanium.

European fruit lecanium. Dormant oils or lime sulfur are suggested for control. (See figure 115.) See Peach.

European red mite. This mite is sometimes found on plums interplanted with apple. See Apple.

Peach borer. The peach borer sometimes infests plum trees. See Peach.

Plum curculio, *Conotrachelus nenuphar.* This beetle hibernates in woodlands and appears in the orchards about the time the trees blossom. It feeds to some extent upon the petals and upon the fruit as soon as it reaches a size of one-fourth of an inch in diameter. It cuts crescent-shaped marks in the fruit and lays an egg under the flap. The

grubs hatching from the eggs live and grow in the pulp of the fruit, which usually drops to the ground and soon decays. The grubs find their way into the ground and pupate and a month later the beetles emerge, feed for a time on the fruit, and go early into winter quarters. The adult is a brown snout beetle about one-fourth of an inch in length, mottled with gray, and with four humps on its back. There is one generation each year. (See figure 116.) See Apple.

Sprays of methoxychlor applied at the time the fruit is one-fourth of an inch in diameter, and repeated twice at weekly intervals and again 4 weeks later have controlled this pest.

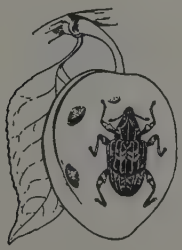

Figure 116. Plum curculio.

San Jose scale. The San Jose scale infests plum, especially Japanese plum. See Apple.

Shot-hole borer. This bark beetle is sometimes found in plum and other fruit trees. See Peach.

Poinsettia

Collar rot, *Rhizoctonia solani.* Dark brown lesions appear on stems at and above ground level and are usually covered with brown mycelium. The plant is effectively girdled, leaves yellow and drop and the plant dies. Roots are also rotted off. This fungus is soil-borne and best controlled by sterilizing cutting media, potting soil, and pots. If the fungus has not progressed too far, soil applications of oxyquinoline sulfate 1:4000 (see p. 5) have proven useful in bringing the plants to flowering.

Stem canker and leaf spot, *Corynebacterium poinsettiae.* Water-soaked streaks in stems and petioles result in yellow blotches and some spotting of leaves followed by defoliation. Badly infected stems crack open, and masses of gold-color bacteria ooze out. A brown discoloration is in the vascular tissue in the stem which extrudes bacterial ooze when cut.

Healthy cuttings taken from healthy mother plants and stuck into sterilized media do not have the trouble. Since infection becomes systemic, sprays are of no value. Prompt roguing coupled with great care in watering may prevent the disease from spreading. Experimental use of Agri-mycin may be helpful.

Black root rot, *Thielaviopsis basicola.* Infected plants are slow growing with small leaves showing bronzed areas between the veins. Leaves eventually drop. Bracts develop irregularly. The fungus enters the plant from the soil through the roots or may be carried in the cuttings. Healthy cuttings stuck in sterilized media and potted in sterilized soil (see p. 4) and pots will not contract the disease.

Poplar

Anthracnose, *Marssonina* spp. Leaves show small circular reddish-brown spots with scattered embedded pustules which exude spores. On white poplar the spores ooze from the upper side of leaves; on other species, from the lower side. Usually this is not serious enough to require spraying.

European canker, *Dothichiza populea.* Sunken dark areas in bark split to expose the reddish-brown discoloration in the sapwood. Callus ridges may grow in from the edge of the canker but infected trunk, limbs, and twigs eventually are girdled and die. In the spring rounded black pustules in the cankered areas extrude creamy tendrils of spores. Water sprouts usually appear in great abundance below cankered areas.

Eastern cottonwood, black and Norway poplars are very susceptible; the Lombardy being the most susceptible. Nursery and plantation stock suffer most from this disease. Destruction of all infected trees is essential. Avoidance of pruning and wounding is advisable, and full dormant sprays of lime sulfur have given good control.

Leaf curl, *Taphrina aurea.* Light puckered areas with orange-yellow reverse side appear on leaves. A whitish bloom may cover

the upper side of the cup. Full dormant sprays of dichlone, zineb, or Bordeaux early in the spring give good control.

Rusts, *Melampsora* spp. In summer dusty yellow eruptions appear on the underside of the leaves and produce spores that infect other poplars. In the fall reddish blisters embedded in the leaves turn black but do not produce spores infective to larch, eastern hemlock, and Douglas fir until spring. The damage to poplar is not considered serious enough to take any control measures.

Scab, *Didymosphaeria populina.* Young leaves and entire shoots blacken and wilt. Under high humidity olive green masses of spores cover discolored tissue. This disease is not serious enough to warrant spraying, but if control is desired, sprays as for apple scab give good results.

Aphids. Several species of aphids occur on poplar. All aphids except possibly the gall-forming species can be controlled by spraying with malathion or nicotine sulfate and soap.

Bronze birch borer. See Birch.

Gypsy moth. Gypsy moth caterpillars commonly feed upon poplar. See Oak.

Oystershell scale. Poplar is very susceptible to infestation by the oystershell scale. See Lilac.

Poplar borer, *Saperda calcarata.* The larva of this long-horned beetle is a borer in the trunk and branches of poplar, and causes blackened and swollen scars. The eggs are laid in slits in the bark during July and August, and the young borers at first tunnel in the inner bark and sapwood but later work deeper in the wood and make larger burrows. They hibernate in galleries and it is believed that 3 years are required to complete the life cycle. The full grown grub is about 2 inches in length. The beetle is about 1¼ inches long and is ash-gray with yellow spots. The only control measures are digging out the grubs or injecting carbon disulfide or nicotine sulfate into the burrows to kill them. Spraying with DDT when the adult beetles are active has been suggested as a control.

Poplar and willow curculio, *Cryptorhynchus lapathi.* This beetle infests and destroys all of the larger pussy willows and also infests the smaller stems and branches of Carolina poplar and probably other species. The adults emerge in midsummer and lay eggs in punctures in the bark. The mature grub is about half an inch in length, white, and without legs. The adult is about one-third of an inch long, black with the distal third of the wing-covers white. (See figure 117.)

Badly infested trees or parts thereof should be cut and burned before the beetles emerge. A penetrating oil emulsion sprayed or brushed on the infested parts of a tree in early spring will kill the larvae. Spraying with DDT during July and August may be helpful in destroying the adults when feeding on the young shoots.

Figure 117. Poplar and willow curculio.

Cottonwood leaf beetle, *Chrysomela scripta.* This is a yellowish beetle marked on the wing-covers with black stripes or spots of variable size, and a trifle more than one-fourth of an inch in length. The beetles appear in early spring and feed on the tender shoots. The females lay yellowish eggs in clusters on the under leaf surface, and the black grubs skeletonize the undersides of the leaves. There are probably three or four broods each season and the insect hibernates as an adult. Another species is smaller, more reddish with black spots, and in certain seasons is just as abundant and injurious as the poplar leaf beetle. DDT will control adults and larvae when needed.

Poplar leafhopper, *Idiocerus scurra.* Occasionally this leafhopper is exceedingly abundant on poplar and must cause some injury as all the insects suck the sap. When treatment seems necessary the trees may be sprayed with DDT or malathion while the nymphs are feeding on the underside of the leaves.

Poplar sawfly, *Trichiocampus viminalis.* The larvae of this sawfly feed together side by side on poplar leaves, often stripping the

trees. The larva reaches a length of two-thirds of an inch and is orange-yellow with two dorsal rows of large black spots, with a row of smaller spots on each side, and a black head. There are two annual generations, the first brood larvae appearing in June and the second in August. In severe infestations the trees may be sprayed with DDT, malathion, or lead arsenate.

Poplar tentmaker, *Ichthyura inclusa.* Caterpillars of this insect are present in May and June and again in August and September, indicating that there are two broods each season. They make small nests or tents near the tips of the twigs. The mature caterpillar is about 1½ inches in length, color dark brown, striped lengthwise with narrow yellow lines, and black head. On each of the fourth and eleventh segments there is a pair of pointed tubercles. The adult moth has a wing spread of 1¼ inches, and is brownish-gray with the apical third of forewings darkened with reddish brown and marked with fine white lines. This insect seldom defoliates trees but when it is abundant, the trees may be sprayed with DDT, malathion, or lead arsenate.

Red-humped caterpillar. See Apple.

Spiny elm caterpillar. Clusters of spiny elm caterpillars commonly feed on poplar and willow. See Elm.

Tussock moths. Caterpillars of the tussock moths also feed upon poplar. See Hickory.

Willow leaf beetle. See Willow.

Poppy

Bacterial blight, *Xanthomonas papaveri-cola.* Infection first shows as water-soaked areas, which soon become black, surrounded by a translucent ring. Sometimes bacterial exudate may be found on the spots. Spots may appear on leaves, stems, buds, flowers, and seed pods. Plants die when stems are girdled. Roguing has been the only control in the past but Agri-mycin sprays may be tried experimentally. Applications made to plants and soil around plants may be more effective than to plants alone and should be started as soon as infection is noted. It is better to plant clean seed in areas where the disease has not made any appearance.

Aphids. The bean aphid commonly infests poppy and the green peach aphid occurs upon it. A spray of malathion, lindane, or nicotine sulfate and soap will control these aphids.

Portulaca

White rust, *Albugo portulacae.* Leaves and branches are swollen, deformed, and covered with white pustules. Shoots become erect and spindling. Since this fungus attacks members of the mustard family, planting at some distance away will help avoid the trouble. Sprays of Bordeaux or zineb plus spreader may be useful.

Potato

Injury from a disease may be seen in seed, in the field, and later in harvested tubers. However, each disease is characterized by the season in which the grower finds it causing severe damage. Diseases are here listed under the season in which they are generally first noticed.

Diseases seen in seed

Ring rot or bacterial wilt. Bacteria rot out the vascular ring which is located about one-eighth of an inch beneath the skin of the tuber. At first the rest of the tuber is sound, and cheesy ribbons can be squeezed from the ring of a cut, diseased tuber. Later the interior of the tuber rots, leaving a shell of firm tissue. In the field diseased plants wilt during August, drop their leaves, and die. Diseased tubers are produced. Ring rot bacteria are carried in seed. The bacteria are highly infectious and spread rapidly during cutting and planting. When clean seed is used and equipment or containers that have come in contact with diseased tubers are disinfected with 1 pint of 40 per cent formaldehyde or 3 pounds of copper sulfate in 15 gallons of water, the rapid spread does not occur.

Blackleg. Bacteria cause a black, soft rot spreading from the stem-end of tubers to the interior. In the field diseased plants become erect, and the young leaves curl. Later, stems at the soil line become slimy and black, and decaying tubers are produced.

Blackleg bacteria are carried in seed and possibly are present in soil. Decaying seed and low, wet soil increase losses. During cold weather planting whole seed or cut seed healed before planting has been shown to be helpful. Cut seed can be healed by holding at 60 to 70°F. and about 85 per cent relative humidity, with adequate ventilation, for about a week. Treating seed with a bac-

Figure 118. Potato tubers showing injury from ring rot (left), blackleg (center), and wilt (right).

tericide prevents spread during cutting and planting. See soft rot and dry rot.

Soft rot and dry rot. Soft rot is caused by bacteria that break tubers down in a soft, slimy, stinking decay. Dry rot is caused by pink, yellow, white, or gray fungi that can be seen in cavities in tubers. Rotting seed pieces in the field cause missing hills.

Rot organisms are present in seed and soil, but they enter only injured tubers. Decaying seed and low, wet soil decrease stands. Whole seed or cut seed healed before planting improves stands. Treating seed by dipping in a compatible mixture of fungicide and bactericide prevents spread during cutting and planting. Controlling blight in the field, preventing wounding of tubers during harvesting and grading, and leaving decayed tubers in the field all decrease losses from decay. If tubers harvested for table stock are stored for 2 to 3 weeks at 55 to 60°F. and then at 40-45°F. and 85-90 per cent relative humidity, shrinking and decay due to wounding are decreased.

Figure 119. Potato late blight.

Diseases seen in the field

Late blight. Late blight becomes epidemic during cool, wet weather when the fungus can produce spores and infect additional leaves nearby. Infections appear on leaves 5 to 7 days after a rainy period as pale green, moist areas. In wet weather the areas increase in size overnight, the centers die, and a ring of white mildew appears on the lower side of the leaf around dead areas. Under favorable conditions the entire plant may be killed. Severely blighted fields smell of decaying plants. Live fungus from blighted foliage can infect tubers. The resulting decay is firm and brown, spreading inward from the surface. Later other parasites enter, and both dry and soft rots develop.

During cool, wet weather the late blight fungus is carried from shoot to shoot through the air and from shoot to tuber by contact. Cull piles can be a source of spores if they are not destroyed. Spraying foliage, especially during wet weather, with nabam plus zinc sulfate, zineb, neutral copper, or Bordeaux fungicide at 5 to 10 day intervals decreases infection. If vines are killed several days before digging, tuber infection is decreased. If decay is found, its development will be slower if the storage is cooled rapidly to 40°F.

Early blight. Fungus spreads to leaves through the air during warm, wet weather. It produces brown spots that may enlarge to one-half inch in diameter. Each large spot shows a series of concentric rings, giving it the appearance of a target. Later the fungus can spread to tubers, where it causes shallow decay. Early defoliation, however, is the most serious damage.

Early blight fungus spreads in much the same way as the late blight fungus. However, early blight is favored by warm weather, late blight by cool, wet weather. Early blight is best controlled by the organic fungicides that are effective against late blight.

Figure 120. Potato early blight.

Verticillium wilt. This wilt, which has become general in Connecticut fields, is most evident in late August and September. Lower leaves become yellow and die, and the denuded stem holds up a flag of wilted upper leaves. The inside of the stem is discolored. "Pink eye" of the tubers is frequently associated with wilt. The vascular ring may be discolored at the stem-end of the tuber. *Verticillium* is carried in seed and soil and infects the plant beneath the ground. Seed from severely infected fields increases infection. Extended rotations seem to give some benefit. The highly susceptible Kennebec and Russet Burbank varieties are severely diseased in heavily infested fields; Katahdin and Green Mountain varieties have performed better in such situations. Chemotherapeutants for controlling the disease in the plant are being tested but have not been perfected for commercial use.

Rhizoctonia (Black scurf). Fungus attacks the plant beneath the ground and in severe infections kills sprout before they reach the surface. More commonly it produces rusty-brown lesions on the underground main stem and white mold on the stem just above the soil line. The number of tubers may be increased and their size decreased. Black, thin bodies (black scurf) are found stuck tightly to the tubers, especially when tubers are washed. *Rhizoctonia* is present on seed and in soil, infecting a wide variety of plants. Seed with a great deal of black scurf increases infection. If rapid growth of the plants is encouraged, the potato can outrun *Rhizoctonia.*

Virus. Potatoes are susceptible to several viruses causing mosaic or leaf distortion and mottling, leaf roll, yellow and purple top, and "spindle tubers." Viruses are carried in the seed from season to season. In the field they are generally spread by aphids or leafhoppers. If clean seed is used, little infection will occur. Early control of insects can be used to prevent spread in the field, especially if seed is to be saved.

Stem decay. Bacteria and fungi attack damaged stems and rot them off above ground, especially under wet conditions. The shoot above the decay wilts and dies. Since the parasites enter through insect and machinery injuries, infection is reduced as injuries and too frequent irrigation are reduced.

Diseases seen in harvested tubers

Common scab. Fungus infects tubers and produces russetted areas or small, brown spots that later become large, corky pits. Scab is most severe in soils of neutral or alkaline reaction. Scab fungus is present in soil and also on scabby seed. Scabby seed increases the amount of fungus in the soil. Liming soil to a pH above 5.2 and applying fresh manure just before planting increases infection.

Defects not produced by parasites. Hollow-heart potatoes are large, overgrown tubers; preventing overgrowth prevents hollow heart. Blackheart is caused by too high temperatures in storage and, hence, insufficient oxygen in the center of the tuber. Off-shape tubers and growth cracks occur in certain varieties, for example Green Mountain and Russet Burbank, due to uneven growing conditions. Jelly-end rot appears at the tips of off-shape tubers. Enlarged lenticels or "pores" are caused by excessive soil moisture before harvest. Tubers cooled below 29°F. show net necrosis or dark blotching of the internal tissue and lack firmness.

Blister beetles. Several species of blister beetles feed upon potato. The treatment usually applied to potato for flea beetles should control this pest.

Colorado potato beetle, *Leptinotarsa decemlineata.* Both larvae and adults feed

upon the leaves, and there are two annual generations. The insects hibernate as adults under rubbish or in the soil, and they emerge and feed upon the first potato shoots to appear. Later, the females lay clusters of yellow eggs on the undersides of the leaves. These eggs hatch and the larvae or grubs begin at once to devour the leaves. The grubs are strongly convex, and dark red with a black head and two rows of black spots on each side. In the last larval stage the red is somewhat lighter in color, and the grub is half an inch or slightly more in length. The beetle is strongly convex, yellow with longitudinal black stripes, and is about three-eighths of an inch in length. Each wing-cover has five stripes, and the thorax has two somewhat diamond-shaped black spots in the center and from four to six small spots on either side. (See figure 121.) Sprays used to control the potato flea beetle have controlled this insect as well.

Figure 121. Colorado potato beetle.

Cutworms. Ordinary cutworms may be a problem in a few potato fields. They cut off new growth and may possibly damage young tubers. Treatment to control them is usually unnecessary. If abundant, dieldrin or heptachlor sprays should control them.

European corn borer. The larvae of this insect tunnels stalks. The openings made in the stalk provide entrance for disease. Control measures for the potato flea beetle begun in late May or early June will reduce injury by this pest.

Four-lined plant bug. This bug sometimes injures potato. No special control is required. See Currant.

Figure 122. Potato aphid injury.

Potato aphids. Three species of aphids commonly infest potatoes in Connecticut. These are the green peach aphid, *Myzus persicae,* the potato aphid, *Macrosiphum solanifolii,* and the buckthorn aphid, *Aphis abbreviata.* All three species normally pass the winter as glossy oval black eggs. The green peach aphid overwinters on peach trees, the potato aphid on roses, and the buckthorn aphid on buckthorn. The eggs hatch in the spring when the leaf buds first unfold. The aphids live on these hosts for two or three generations and then migrate to potato and other herbaceous plants. Although the infestation usually does not become noticeable in Connecticut until in July, aphids are usually present in small numbers on the plants in June. If potato virus diseases are present, these aphids will spread them in the field. Severe infestations of aphids will cause leaves to die and may kill plants in July, August, or September if they are not controlled. (See figure 122.) Malathion spray or dust will effectively control the aphids on potato.

Potato flea beetle, *Epitrix cucumeris.* This is a small black jumping flea beetle that feeds upon the leaves of potato, tomato, tobacco, and many other plants, eating out small round holes from the underside, but leaving the upper epidermis. The remaining tissue soon dies, however, and falls away, leaving holes through the leaves which turn yellow and later turn brown and die. This beetle is not much more than one-sixteenth of an inch in length. It lives through the winter under rubbish and in other sheltered places, and may first be found in the spring on plantain and other weeds, sometimes also on the leaves of apple, wild cherry, and maple. As soon as the preferred food such as potato and tomato plants appear in the garden or field,

the flea beetles gather upon them for a feast. The overwintering beetles lay eggs in the soil in June. The larvae feed upon tubers and roots of the host plants. An abnormal growth sometimes takes place around each injury, causing scurfy and pimply potatoes. The larvae transform and their beetles emerge early in July. (See figure 123.)

These beetles feed on the potato foliage as long as the plants are green and temperatures are favorable. These insects then hibernate until the following spring. If the flea beetles are controlled in the spring when they first begin feeding, fewer beetles will be present in the fall and the following spring. Dieldrin or heptachlor sprays or dusts will effectively control the potato flea beetle.

Figure 123. Flea beetles on potato.

Potato leafhopper, *Empoasca fabae.* This leafhopper is responsible for the tip burn or "hopper burn" of potato. The remedy is spraying or dusting with malathion.

Potato stalk borer, *Trichobaris trinotata.* The larvae of this snout beetle may be found boring in infested stalks. It has not been a serious pest and no control measures have been required.

Stalk borer. The stalk borer sometimes tunnels in potato stalks. See Dahlia.

Three-lined potato beetle, *Lema trilineata.* This is a reddish yellow beetle, about one-fourth of an inch long, with three black stripes running lengthwise on the wing-covers. Probably this beetle hibernates as an adult and there are said to be two annual generations. The beetles appear when potato and tomato plants are growing in the field and lay their small clusters of yellow eggs on the undersides of the leaves. The yellow larvae feed side by side and move backward from the leaf margin as they devour the leaf tissue. They carry a coating of brown excrement on their backs. The beetles become full grown in about 2 weeks, when they are about one-third of an inch long, and enter the ground to pupate. This pest is controlled by the sprays and dusts used for the control of the potato flea beetle.

Tortoise beetles. Like sweet potato and morning glory, the potato is sometimes eaten by tortoise beetles. The usual treatment for flea beetles will control these tortoise beetles. See Sweet potato.

White grubs. White grubs often cause severe injury by eating the tubers. They are most common in land recently in sod. Usually the damage is discovered too late for control. The control is application of aldrin, dieldrin or heptachlor to the soil before potatoes are planted.

Wireworms. Shiny, hard-skinned wireworms sometimes damage potatoes by tunnelling into seed pieces, roots, stems, and new tubers. Potatoes following sod may be damaged by larvae of the corn *Melanotus communis* or the wheat wireworm *Agriotes mancus.* These usually occur in the heavier potato soils and tend to disappear with continued cultivation. Potatoes planted continuously in light sandy soils may be damaged by larvae of the eastern field wireworm *Limonius agonus.* Continued cultivation encourages this species. Fields found infested after growth has begun may be harvested as early as practical to avoid further damage. Wireworms can be controlled by applications of aldrin, chlordane, or heptachlor made before planting and harrowed immediately into the soil. One application has been effective for at least 3 years.

Primrose

Leaf spot, *Ramularia primulae.* Ash-colored blotches with yellow borders appear on leaves. Other leaf-spotting fungi also produce spots on primula leaves. The disease may be reduced by picking and destroying affected leaves, by cleaning up old leaves in the spring, and by spraying with Bordeaux before infection occurs or as soon as noted.

Bacterial leaf spot, *Pseudomonas primulae.* Small yellow leaf spots one-eighth to one-quarter inch in diameter may merge to kill large areas of the leaf. Spots at first may be water-soaked with a yellow center and when larger have a yellow halo. Since watering spreads the disease, syringing is to be avoided. Experimental control with sprays of Agri-mycin may be tried, starting as soon as spots first appear. Picking and destroying affected leaves is helpful.

Brown root rot, *Thielaviopsis basicola.* Small black lesions on the roots enlarge to rot the roots completely. Older leaves yellow and die; younger leaves appear mottled. Since this fungus is found in the soil, planting clean plants in sterilized soil (see p. 4) gives effective control.

Root-and-crown rot, *Rhizoctonia solani.* Plants yellow and die. The crown and roots are rotted and covered with brown mycelium. Soil drenches with oxyquinoline sulfate 1:4000 (see p. 5) give good control if applied in time.

Foliar nematode, *Aphelenchoides fragariae.* Crown and buds are stunted; leaves are curled and distorted. Roguing of diseased plants and removal of surrounding soil is indicated.

Greenhouse whitefly. This insect infests primroses in greenhouses. See Cineraria.

Slugs. In the garden, primroses are often eaten by garden slugs. Spraying or dusting with chlordane or dieldrin has given good control of slugs.

Privet

Anthracnose and twig blight, *Glomerella cingulata.* Cankers develop on main trunk near ground level. These cankers enlarge and girdle the plant. Leaves above the canker turn pale green, then brown, and remain attached for awhile. Infected bark is brown, and wood beneath is brown or greyish black. European privet, *Ligustrum vulgare,* appears to be very susceptible to this disease but California, Amur, Ibota, and Regal privets are resistant. Use of resistant varieties appears to be the easiest method of control.

Stem galls, *Phomopsis* **sp.** Galls 1½ inches in diameter are formed on trunk and branches. Heavily infected plants die. No spray measures are known to control it.

Powdery mildew, *Microsphaera alni.* White mealy appearance on upper surface of leaves indicates this fungus. Sulfur dusts or sprays give good control if applied as soon as mildew appears.

Root rot, *Armillaria mellea.* Leaves are small, growth is slow and followed by dieback of branches and death of parts of the hedge. Black fungus cables resembling shoestrings may be found in the soil around the roots and main trunk. Rotted bark may show white mycelial fans on the underside.

Adequate control can be obtained by a soil injection with phenyl mercuri monoethanol ammonium acetate (see p. 120) around lightly infected shrubs or at the edge of dying shrubs to prevent spread to healthy plants.

Leaf roller, *Archips rosana.* This small caterpillar webs together the terminal leaves of California privet in May, making a case within which it lives and feeds. When fully grown it is three-fourths of an inch in length, and green with a dark brown head. It pupates in the webbed leaves and the moths emerge about the middle of June. In color the forewings vary from light brown to olive brown and are crossed by darker markings. The eggs are laid in June on the twigs and remain there and hatch the following spring. As most of the webbed leaves are clipped off in trimming the hedge no other control measures are necessary. Spraying with DDT or malathion will control leaf rollers if they cause serious damage.

Lilac borer. This insect is also an occasional borer in privet. See Lilac.

Mites. Mites infest the tender tips of California privet in spring and early summer, which results in the leaves being stunted, thickened and curled. Some of them drop. Spraying with malathion or aramite late in the spring and again about 2 weeks later may control these mites. Sometimes an additional treatment is required later in the season.

Thrips. This insect injures privet, and may be controlled by spraying several times each season with DDT, dieldrin, or malathion. See Circular 201.

Pumpkin

Aphids. Several kinds of aphids such as the melon aphid, the squash aphid, and the potato aphid, may occur on pumpkin. See Squash.

Melonworm. This insect also infests pumpkin. See Melon.

Squash borer. This borer may cause injury to squash and pumpkin, but as pumpkin is usually planted late it escapes injury more often than squash. See Squash.

Squash bug. The squash bug commonly feeds upon pumpkin. See Squash.

Squash lady beetle. This insect sometimes feeds upon pumpkin. See Squash.

Striped cucumber beetle. This insect may injure pumpkin if plants are grown early in the season. See Cucumber.

Quince

Black spot, *Fabraea maculatum.* This common disease of quince can cause severe injury if not controlled. On the leaves the disease shows as small circular spots, reddish brown on the periphery, with black centers. In the centers numerous minute black spore bearing pustules can be seen. A heavy infection will cause extensive defoliation. The fruit infections appear as irregular sunken black spots scattered at random over the surface. The spots may become confluent and cause cracking of the fruit. The causal fungus overwinters on the old leaves, producing two types of spores in early summer. These start new infections on the foliage and young fruit. Spraying with ferbam during June is the suggested control. It is interesting to note that Thaxter conducted perhaps the first successful control experiments at this Station in 1890.

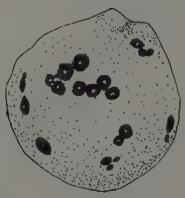

Figure 124. Black spot on quince.

Rust, *Gymnosporangium clavipes.* This rust occurs on the leaves, stems, and fruit. On the leaves it produces small orange-colored spots, an the stems it causes swollen gall-like growths, and on the fruit it appears as circular orange-colored areas which may comprise half the surface area. On all infected parts of the plant the brilliant orange spores are borne in very small, white, toothed cups. See Apple.

Fire blight, *Erwinia amylovorus.* Fire blight is more common and serious on quince than on apple but not as destructive as on pear. See Apple and Pear.

Fruit speck, *Mycosphaerella pomi.* Not common on quince but is mentioned because of a slight similarity to black spot. See Apple.

Black rot. See Apple.

Aphids. Quince is infested by the green apple aphid, *Aphis pomi,* the apple grain aphid, *Rophalosiphum fitchii,* and the woolly apple aphid, *Eriosoma lanigerum,* all of which infest the apple. See Apple.

Codling moth. The codling moth also infests the quince. See Apple.

Lacebugs, *Corythucha cydoniae.* These small sucking insects have large lacy wings. They feed on the under surface of the leaves. The adults hibernate over the winter under leaves on the ground. Sprays of DDT as applied to control curculio also kill lacebugs.

Oriental fruit moth. This is now the most destructive insect pest of quince in Connecticut. Infestations continue late into September. Sprays of methoxychlor are required until about 3 weeks before harvest to control this pest in quinces. See Peach.

Quince curculio, *Conotrachelus crataegi.* Until the advent of the Oriental fruit moth, this was the most destructive quince insect in Connecticut, and now must take second place. The beetles appear in midsummer and lay eggs singly, usually about the middle of July. The eggs hatch in from 7 to 10 days and the grub tunnels through the flesh, rarely reaching the core. Few of the infested fruits drop and in about 30 days, usually in August, the mature larvae begin to leave the fruit and make cells 2 to 3 inches deep in the soil where they hibernate and pupate the following spring. From 10 to 20 days after pupation the adults emerge. The grubs are flesh-colored and without legs. The adult beetle is about one-fourth of an inch in length and brownish-gray in color. There is only one brood each year. Although this pest is difficult to control, thorough and repeated applications of DDT will greatly reduce the injury.

Resplendent shield bearer, *Coptodisca splendoriferella.* The tiny caterpillars of this insect are leaf miners and when fully grown cut out shield-shaped portions of the leaf for cases which they fasten to the bark.

The second brood caterpillars hibernate in these cases. The little moths emerge in May. The basal half of their forewings is lead gray and the apical half golden with streaks of dark brown and silver. This is not a serious pest. The usual sprays for other pests have controlled it.

San Jose scale. The San Jose scale commonly infests quince. See Apple.

R

Radish

Black root rot, *Aphanomyces raphani.* Radish roots infected with this fungus disease show sunken dark streaks and blotches. As the disease progresses, the blotches may develop into a dry rot which tends to distort the shape of the growing root. The fungus lives in the soil. To avoid the disease, start seedlings in pasteurized soil, and practice crop rotation.

Aphids. The turnip aphid, green peach aphid and cabbage aphid have all been recorded from radish. Usually the plants grow so rapidly that they are ready to harvest before they are seriously injured by aphids and special controls have not been necessary.

Cabbage maggot, *Hylemya brassicae.* This insect often injures radish, especially early in the season. In the spring, small gray flies emerge from their overwintering puparia in the soil and deposit eggs in the soil near the plant stems. These hatch into small white maggots which tunnel in the roots and cause wilting and stunting of the plants. Heptachlor or dieldrin applied to the soil around the base of the plants when they are about 1 inch high may be used for control.

Diamond-back moth. This insect feeds upon radish. See Cabbage.

Garden springtail. Young radish plants are occasionally severely injured by this insect. See Beet.

Radish maggot, *Anthomyia radicum.* This insect sometimes causes severe injury to radish in a manner similar to that of the cabbage maggot. See Cabbage.

Raspberry, Red and Black

Mosaic. This virus disease of both black and red raspberry is characterized by a yellow chlorotic mottling of the leaves, frequently masked by high summer temperatures. Foliage development is delayed in the spring, and fruit is small and of poor flavor. Mosaic is more severe on black than on red raspberry. The virus is transmitted by aphids and cannot be transmitted mechanically. There is no control. Planting of virus-free plants delays the appearance of mosaic but does not prevent it.

Leaf curl. Leaf curl, another virus disease, differs from mosaic by the absence of chlorotic mottling and shows a crinkling and downward curling of the leaf. The foliage is dark green with a stiff dry appearance, bronzed and shining in the late summer. Berries are small and poor as in mosaic. No control is known.

Anthracnose, *Gloeosporium venetem.* On the leaves the fungus causes small circular white spots with purple borders. In heavy infections these may cause defoliation. Infection on the canes is colored the same as on the foliage, but the areas are bigger and can cause serious damage, either killing the cane or weakening it so that winter temperatures complete the killing. In wet seasons this fungus may kill the fruit stems and destroy part of the crop at picking time. Our experience has shown that cutting out the old canes immediately after picking and spraying in the spring with ferbam when the new canes are 4 to 12 inches high will control this disease on both red and black raspberries.

Cane blight, *Leptosphaeria coniothyrum.* The symptoms of this disease are shallow cankers on the stem on which the bark is a light gray color with no colored border. The bark on typical infected areas is thickly sprinkled with minute black fruiting pustules of the fungus. The cankers girdle the stem, causing it to wilt and die. This killing may occur on the young canes or in the second year as the fruit begins to ripen. The control is the same as for anthracnose.

Crown gall, *Agrobacterium tumefaciens.* This is the same bacterial disease as described on apple. Usually unimportant, at times it may produce elongated galls which girdle and kill the entire stem. There is no control except perhaps cutting and burning the infected canes.

Botrytis fruit rot, *Botrytis* sp. During rainy weather the ripening fruit is rotted by this fungus. The rotted fruits are more or less covered with a gray mold if the wet spell lasts 2 or 3 days. If the rain is of short duration there may be only a few segments of the berry injured, these usually are next to the stem. In most seasons the loss is not very great from this trouble. No satisfactory controls have been developed.

Powdery mildew, *Sphaerotheca humuli.* This trouble is usually of very little importance on raspberry although in some locations it is troublesome. See Rose.

Aphids. At least two species of aphids occur on raspberry, though they are seldom abundant, and their direct injury is not so much to be feared as the probability that they may transmit and spread mosaic and related diseases. These aphids are *Aphis rubicola* and *Amphorophora rubi,* and both are found scatteringly on the undersides of the leaves. Control consists of spraying with nicotine sulfate and soap, or malathion.

Japanese beetle. This beetle, and others feeding while fruit is ripening, can be controlled to some extent by use of rotenone dust.

Raspberry cane borer, *Oberea bimaculata.* This insect is one of the long-horned beetles which appear in June. The female makes two rows of punctures around the tip of the shoot about half an inch apart, then lays an egg in the stem between the girdles. The tip wilts and this injury is thought to protect the egg from being injured by too rapid growth of the shoot. The egg hatches in early July and the grub burrows downward in the pith and hibernates in the cane only an inch or two below the girdle. The second season it continues to burrow downward, usually killing the cane, reaches the ground by the second winter, and hibernates in the burrow. The following spring it pupates in the burrow and the adult beetle may emerge in May or June. Two years are required for the complete life cycle. The adult beetle is about half an inch long and has black wing-covers and yellow thorax, usually with two or three black spots. The only control is to cut out and burn the wilted fruiting canes, and also the wilted tips, cutting below the lower girdle.

Raspberry cane maggot, *Pegomya rubivora.* The adult of this insect is a two-winged fly that appears late in April. When the raspberry shoots are a few inches tall, the fly lays an egg in the axil of one of the tip leaves. The egg soon hatches and the maggot crawls down the stem for a short distance, then goes into the stem and tunnels downward in the pith. It works its way nearly to the bark and cuts a tunnel around the shoot, thus girdling it, and the tip wilts. The maggot reaches maturity in late June or early July, pupates in the burrow, and the adult fly emerges the following spring. There is one generation each year. The only control is to cut several inches below the girdle and burn all wilted tips in May.

Raspberry fruitworm, *Byturus rubi.* Raspberry plants are often injured by small brown beetles that eat holes in the tender terminal leaves and devour the blossoms. The female lays eggs in May on the base of the blossom buds, on bud and leaf stems, in cavities in buds or on leaves. After the buds open, eggs are laid in the blossoms. The eggs soon hatch and the larvae work and develop inside the fruit and the fleshy receptacle, often causing the fruit to dry up. The larvae often adhere to the picked fruit. They are about one-fourth of an inch long, light yellow with a cross band of light brown on the back of each segment. The beetles are light brown, hairy, and about one-sixth of an inch in length. Spraying with methoxychlor when blossom buds first appear, and again just before blossoms open, has given control.

Raspberry root borer, *Bembecia marginata.* The raspberry root borer tunnels in the main roots and crowns of blackberry and raspberry plants. The adult is a clear-wing moth having a wing spread of an inch, with transparent wings and black body crossed by four yellow bands. It emerges in August and deposits eggs underneath the leaves. The first winter the small larvae hibernate in blister-like elevations of the bark just beneath the soil level, or in crevices, or under flakes of bark at the base of the stems. In the spring they tunnel in the stems and roots just beneath the bark, often girdling the plants. They hibernate in their burrows the second winter and the following spring tunnel upward either in the pith or just under the bark. They finally reach a length of nearly an inch. In July they burrow to the surface and pupate in the tunnel. When ready to emerge, the pupa works its way partly out of the tunnel when the case splits open and the moth escapes, leaving the pupa case protruding from the burrow. Infested bushes usually wilt at the top or die, and the only remedy is to dig out the borers or remove and burn the infested plants.

Raspberry sawfly, *Monophadnoides rubi.* Serious injury is often caused by green spiny

larvae, about three-fourths of an inch long, that feed on the leaves. The adult is a black sawfly about one-fourth of an inch in length. In May the adult lays eggs singly in the leaf tissue near a prominent vein. The eggs hatch in a week or so and the larvae feed upon the leaves. When abundant they may devour all of the foliage. They reach maturity in about 10 days, go into the ground where they hibernate, and pupate the following spring. There is one brood each season. The remedy is to spray with methoxychlor before the plants blossom.

Rose scale. Raspberry is one of the host plants for rose scale. See Rose.

Tree cricket, *Oecanthus nigricornis.* Of several species of tree crickets occurring in Connecticut, this one has the habit of laying its eggs in small twigs of raspberry and blackberry canes. The egg punctures either kill the cane above this point or so weaken it that the fruit cannot develop. The canes often break off at the egg punctures. This tree cricket is yellow with black legs and antennae and is about five-eights of an inch in length. In pruning the canes, those containing eggs should be cut off and burned.

Two-spotted mite. This general pest also feeds on raspberries. See Apple.

Redbud (Judas Tree, Cercis)

Leaf spot, *Mycosphaerella cercidicola.* Spots are rusty brown at first with a raised border, but later the upper surface appears grey while remaining brown on the underside of the leaf. Raking and burning fallen leaves prevents the fungus from overwintering. Sprays of ferbam, thiram, or Bordeaux applied when leaves are half grown and full grown give good control.

Canker and dieback, *Botryosphaeria ribis.* Sunken elongated cankers may occur on branches or trunk and may enlarge to girdle it. Pruning infected material well back of any discoloration in the wood is successful only on young cankers.

Rhododendron

Leaf spots. Several fungi cause leafspotting on rhododendron leaves as a secondary effect of the bush being in poor condition from some other cause. These fungi may be prevented by sprays of ferbam, thiram, or Bordeaux plus a spreader applied to new growth when half grown and again when full grown. However, if the primary cause of the poor condition is found and corrected, spraying is usually unnecessary. Removal and burning of affected leaves reduces the possibility of spread.

Azalea leaf scorch, *Septoria azaleae.* Small yellow spots on azalea leaves become dark reddish-brown with purple borders. Several sprays of ferbam, thiram, or zineb on new growth will protect leaves from infection.

Leaf curl, *Exobasidium vaccinii.* This fungus is common on members of the rhododendron family, especially wild azaleas. The shoot leaves become swollen and curled, forming an irregular gall which is pinkish, later becoming white when spore formation occurs. On rhododendrons the flower parts may be involved but on azaleas it is chiefly leaf tissue. These swellings are known as pinkster apples, or swamp apples, or honeysuckle apples. A full-dormant spray of lime sulfur or ferbam will prevent development of this disease. The disease may be reduced by hand-picking and destroying all galls.

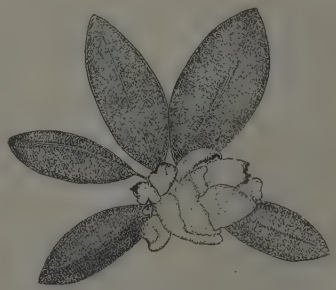

Figure 125. Flower gall on rhododendron.

Rust, *Pucciniastrum myrtilli.* Many of the Heath family are susceptible to rust, including azaleas, rhododendrons, and blueberries. Small pustules appear on the underside of leaves. These pustules burst open to discharge bright yellow or brownish spores that reinfect the rhododendrons or azaleas. The alternate host is the eastern hemlock, and the cluster cup stage appears on its needles. This stage is not necessary to the spread of the fungus among the Heath family

as the summer stage can overwinter on rhododendron. Spraying new leaves with ferbam or zineb plus a spreader before infection occurs helps control the disease.

Powdery mildew, *Microsphaera alni.* Whitish dust may appear on azalea leaves during hot dry weather. Sprays of sulfur applied in the afternoon as the plant develops will control the fungus.

Azalea bud and twig blight, *Sporocybe azaleae.* The first sign of this disease is the dwarfing of flower buds followed by their browning and death in late summer or early fall. The fungus can be found fruiting on the buds, the fruiting bodies resembling tiny pins stuck into the buds. Picking and burning infected plant parts either in late fall or early spring will help materially to reduce infection. Seed pods can also be removed as soon as flowers have withered.

Damping-off and root rot, *Rhizoctonia solani.* This fungus is widespread and causes more trouble with rhododendrons than is generally realized. *Rhizoctonia* can kill small or large bushes or just keep them in poor condition. Symptoms may include chlorosis of terminal leaves or shoot dieback, or in young plants a slow decline and death. The fungus is omnipresent in the soil and appears to be most virulent at high nutrition levels. Microscopic examination of roots and crown are the surest diagnosis. A soil drench with oxyquinoline sulfate (see p. 5), and correction of any unfavorable environmental conditions can bring the affected bush back if not too far gone. In severe infestations several applications may be necessary.

Shoestring root rot, *Armillaria mellea.* The same off-color condition in rhododendron and azalea can be caused by the shoestring fungus. Its presence is indicated by whitish mycelial fans under the bark and the presence of shoestring-like rhizomorphs in the soil around the roots, along the roots, and on and under the bark of the crown. If the bush is not too heavily infected, control may be obtained by using a soil drench of phenyl mercuri monoethanol ammonium acetate (see p. 120) at the rate recommended on the label. One application should suffice.

Ice injury. Bright yellow or brown spots regularly spaced along the mid-vein may indicate this trouble. Glaze ice formed on rolled leaves may act as a focusing agent for the sun's rays if ice has not fallen by the time the sun comes out. The injury remains static, with sharply defined edges, as differentiated from the start of nutritional troubles which progress and have indefinite edges.

Chlorosis and winter injury. Rhododendron leaves normally remain green in winter but curl and hang down in very cold weather. Browning on the margins and tips of the leaves occurs when loss of water from the leaf surface is greater than the ability of the roots to absorb water. This happens when roots are injured by recent transplanting, cultivation, insects, fungi, or other mechanical agents. Mole tunnels around roots indicate the presence of grubs. However, these runs may be used in winter by mice which eat the plant roots. Root injury is aggravated by planting in an exposed location. Rhododendrons prefer partial shade. Marginal burning is often followed by semi-pathogenic fungi (see leaf spot).

Concurrent with or independent of this burning is a yellowing of the interveinal areas leaving the tissue green immediately adjacent to the veins. Root injuries may be responsible for this chlorosis. Other causes include soil that is not acid enough, or is poorly drained, or is receiving water from a down-spout from a roof. The addition of too much fertilizer or too much phosphate or lime can have similar results. Careful examination on the spot is very important. All pertinent facts submitted with root and soil specimens for laboratory examination aid greatly in proper diagnosis.

Azalea petal spot and blight, *Sclerotinia azaleae.* Tiny spots appear on petals of flowers (brown spots on white flowers and white spots on colored flowers). These spots enlarge rapidly and destroy the flower. The fungus develops sclerotia in the seed pods which fall to the ground overwinter, producing new spores in the spring to infect flowers.

Sprays of zineb or dichlone applied several times weekly beginning when the buds show color and continuing until petals fall normally will give a good measure of control. Picking and burning affected buds and seed pods before they fall eliminates the overwintering stage.

Azalea bark scale. This scale infests rhododendron. See Azalea.

Rhododendron borer, *Ramosia rhododendri.* Rhododendron stems are sometimes severely injured by white grubs that tunnel under the bark. Severe wounds are formed and the top or side branches wilt and sometimes break off. The grub matures in October, and is then about half an inch long, but it hibernates in the burrow and pupates in the spring. The moths appear in May and June and the females lay eggs on the twigs. The moth is a clear-wing and has a wing spread of about half an inch, wings transparent with brown margins. There is one brood each year.

One method of control is to cut out the borers and injured stems and burn the refuse. The wounds should be coated with tree paint or with paraffin. Spraying with DDT at the time the moths are active in May and June may help control this pest.

Rhododendron lacebug, *Stephanitis rhododendri.* The adults and nymphs of this lacebug suck the sap from the undersides of the leaves. The results of infestation show on the upper leaf surface as a mottled or white peppered appearance, and on the under surface the leaf is brown-spotted with excrement. The winter is passed in the form of eggs inserted on the underside of the leaf, usually near the midrib. They hatch in May and the nymphs become mature in June and lay eggs in June and July for the second brood, the nymphs of which appear in August. These nymphs become mature later and the adults lay eggs in the leaves that hatch the following spring.

The control measures consist in spraying the undersides of the leaves to kill the nymphs and adults, using DDT or malathion. The first spray is required late in May and the second in July.

Pitted ambrosia beetle, *Corthylus punctatissimus.* Plants growing in the shade as well as those that are mulched are sometimes injured by small whitish larvae that make horizontal galleries in the wood at the base of the stem causing wilting and dying. The adult is a beetle about one-eighth inch long, dark brown to black in color and stout in appearance. The wilted branches may be cut out and burned. Spraying the base of the plants with DDT late in the spring will help control the adults.

Rhubarb

Leaf spot, *Ascochyta rhei.* These small, circular, brown spots are scattered over the surface of the leaf. The disease is caused by a fungus. The leaf spot is common in Connecticut, but does not do enough damage to the plant to require special control measures.

Aphids. The bean aphid and green peach aphid sometimes infest rhubarb. Control is not usually necessary.

European corn borer. This insect will sometimes tunnel in the stalks of rhubarb. Control is not generally necessary.

Rhubarb curculio, *Lixus concavus.* The rhubarb curculio makes feeding and egg punctures in the stalks and the sap exudes from the wounds as glistening drops of gum. The eggs laid in rhubarb do not hatch, but are killed by sap. The beetle is about half an inch in length, black, covered with yellow dust, and hibernates as an adult. It feeds upon the margins of the leaves besides puncturing the stalks. They are usually present in small numbers and can be hand-picked and destroyed.

Stalk borer. The stalk borer also infests rhubarb. See Tomato.

Yellow woollybear, *Diacrisia virginica.* This caterpillar sometimes feeds upon rhubarb but does not regularly require control.

Rose

Black spot, *Diplocarpon rosae.* Black spots with fringed margins cause yellowing of leaflets and leaf drop. Black lesions on canes are a means of overwintering for the fungus and may serve to introduce the disease into a hitherto uninfested area. Varieties vary in susceptibility.

Black spot is a persistent pest in rose gardens, and 100 per cent control is almost impossible, despite weekly spraying. One of the combination sprays of ferbam and sulfur (plus insecticides) applied regularly at weekly intervals should give fairly good control of black spot and most other rose diseases. Black spot may be reduced by picking and burning the first infected (lower) leaves in the spring and removal of all fallen leaves from around the plant, particularly in the fall. Covering the soil with a mulch in spring may be helpful. Recent reports indicate that captan sprays applied to plants (drenching

the surrounding soil) stopped an epidemic in one garden. Zineb and ziram will also control black spot but not powdery mildew.

Powdery mildew, *Sphaerotheca pannosa var. rosae S. humuli.* Young leaves curl upward and may be deformed, and young shoots may be killed back. Attacked buds do not open, and on ramblers infected flowers look prematurely wilted and discolored. Regular spraying or dusting with sulfur is essential and for best results should be started as soon as the first leaves unfold. On certain varieties of more susceptible hybrid teas, climbers, and ramblers, control may be more successful if a full dormant spray of lime sulfur is used.

Botrytis blight, *Botryitis cinerea.* Buds of certain varieties turn brown and decay before opening. The grey mold of the fungus may often be found inside or over the outside of the bud. Some varieties are very susceptible to the ravages of *Botrytis,* and the only protection against it appears to be good aeration around plants.

Figure 126. Leaf spot on rose.

Leaf spot, *Mycosphaerella rosicola.* Small yellowish green dots enlarge, spot the leaves, and turn brown with a purplish border. Control is usually obtained by spraying as for black spot. On varieties where black spot is not a problem, one application of ferbam the third week in May gives effective control.

Anthracnose, *Sphaceloma rosarum.* The dark brown to black spots scattered on leaves or calyx lobes eventually develop a whitish center. Tissue may fall out leaving margins ragged. Infection may turn leaves yellow, red yellow, or reddish brown. Smaller lesions occur on stems, thorns, hips, and flower stalks and are usually raised or depressed in the center. Removal of affected parts is helpful. Spraying as for control of black spot may control this fungus, especially if a full dormant application of lime sulfur is made.

Figure 127. Rose rust.

Rust, *Phragmidium* sp. Orange-brown spores are extruded from pustules on the lower side of leaves. Later these turn black with winter spores. Young stems may be split and distorted with this stage. Pruning infected wood and raking and burning fallen leaves is helpful. Sprays of ferbam or zineb applied as for black spot through the growing season should control rust.

Cankers. Various fungi. Differentiation among the canker-producing fungi is unimportant as control is the same for all.

Cankers are difficult if not impossible to control by spraying, but roses left unmulched overwinter seldom contract the disease.

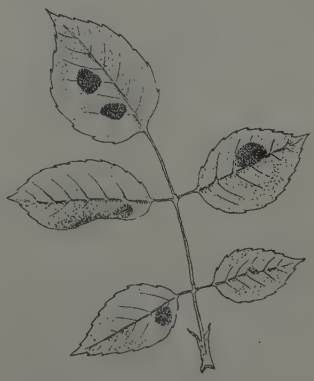

Figure 128. Black spot on rose.

Where roses must be mulched if they are to survive, fall sprays of dichlone or lime sulfur applied to all wood that is to be covered may be helpful. Cutting out of all infected wood in early spring is essential. Making all cuts close to a bud (even when cutting flowers) lowers chances of infection. Dormant sprays of lime sulfur in early spring after pruning have been suggested.

Crown gall, *Agrobacterium tumefaciens.* Irregular or spherical galls appear on roots, crown, or canes. The causal bacteria can be kept out by avoiding wounds. Removal and destruction of infected plants and soil sterilization (see p. 4) or planting in uninfested soil are essential.

Figure 129. Crown gall on rose.

Mosaic. Virus. The typical symptom of this disease is a chlorotic discoloration feathering out from the veins, together with a distortion of the leaflet. Yellow watermarks, vein clearing, or dull yellow blotching may also be virus expression. Symptoms vary sometimes showing only when grown indoors and may appear only on one or several leaves. Since mosaic is transmitted only by grafting, no danger of spreading it in the garden need be considered. Mosaic symptoms may be confused with "crinkle," a non-explained physiological trouble. There are also yellow mosaics in which symptoms are more conspicuous. Mosaic-infested plants commonly lag in growth and produce few if any flowers.

Streak. Virus. Brownish rings and vein-banding or a greenish senescence pattern similar to brown patterns on leaves or canes mark this trouble. Necrotic lesions may appear around the bud and on canes above the bud. Transmission and control are the same as for Mosaics.

Rhizoctonia root rot, *Rhizoctonia* sp. Both greenhouse and garden roses are affected. Slowed growth, sometimes accompanied by wilting at mid-day in hot sun or dropping of lower leaves, is typical of this disease. Fine roots have been rotted off, and the fungus lesions on larger roots are brown and dry. Several soil drenches with oxyquinoline sulfate 1:4000 (see p. 5) results in better growth and renewed vigor in plants.

Aphids. The rose aphid, *Macrosiphum rosae* and the potato aphid, *M. solanifolii.* In the early summer it is a common sight to see the new shoots and leaves thickly infested. These aphids may be controlled by spraying thoroughly with malathion or nicotine sulfate and soap.

Flower thrip, *Frankliniella tritici.* The thrips attack the flower buds, causing discoloration of the petals. This usually results in deformity or failure to mature. The extremely active adult thrip is very small, slender, brownish yellow in color, with feathery wings. The young are lemon colored. There are two or more broods during the summer, occurring at about 2-week intervals during a hot, dry season. Control treatments are the same as those suggested under gladiolus thrip.

Fuller rose beetle, *Pantomorus godmani.* Roses and many other plants in greenhouses are sometimes injured by Fuller rose beetle which feeds on the leaves at night and rests in the leaves or in some protected place during the day. The eggs are laid under the edges of bark near the ground, and the larvae live in the soil and feed upon the roots of various plants. The life history and length of the larval period are not well known, but it is said that all stages occur in the greenhouse during the winter and early spring. Adults are the most abundant in December. This is a brown snout beetle marked with patches of gray scales, and in length it varies from one-fourth to three-eighths of an inch. When the infestation is light, hand-picking the insects is a possibility. Serious outbreaks may be controlled by spraying with DDT. Soil treatment around the plants using dieldrin, chlordane or DDT may destroy the larvae. See Lawns, Japanese beetles.

Imported long-horned weevil. See Pansy.

Japanese beetle, *Popillia japonica.* This beetle in the adult stage feeds upon a great

variety of trees and plants, and rose is one of its favorites. The beetle is about half an inch in length, bright, shining green, with wing-covers a bronzy red or copper color. Two white spots on the tip of the abdomen show beyond the ends of the wing-covers, and there are five white spots formed by patches of white hairs on each side of the abdomen. The beetles begin to emerge the latter part of June; their greatest abundance is usually about the middle of July, but in certain seasons they may disappear altogether. The eggs are laid in July in the soil, and the grubs feed on grass roots near the surface, going downward to a depth of about a foot to hibernate. Late in April they ascend to the surface, feed for a time, then enter the prepupal stage, and pupate late in May or early in June. From 2 to 4 weeks later the adults emerge. There is one generation each year. (See figure 130.)

Feeding on the foliage of roses can be prevented by sprays or dusts of DDT or chlordane. It is difficult to protect the blossoms by use of sprays or dusts. Treatment of lawn areas should reduce the number of beetles. See Lawns, and Bulletin 505.

Red spider. See Phlox.

Figure 130. Japanese beetle.

Rose chafer, *Macrodactylus subspinosus.* When very abundant, this insect injures roses and many other shrubs and trees by the beetles skeletonizing the leaves. They also cause injury to the flowers, particularly white flowers, by feeding upon the petals and soiling them with excrement. Rose chafers breed most abundantly in sandy waste land but often occur in lawns; they appear each year about June 10 to 12, and feed for about a month, though some of the beetles are present for 6 weeks. The females each lay from 24 to 36 eggs singly in the ground a few inches beneath the surface. They soon hatch and the young grubs feed upon the roots of grass and other plants, becoming full grown by late autumn when they go into the ground several inches to hibernate. The next April or May they come near the surface and transform to pupae in earthen cells, and from 2 to 4 weeks later the beetles emerge. The adult beetle is yellowish grayish brown or clay colored and is about one-third of an inch long, with long sprawling legs. The larva is a white grub about three-fourths of an inch in length when full grown. (See figure 131.) For control see Japanese beetle above. See also Bulletin 575.

Figure 131. Rose chafer.

Rose curculio, *Rhynchites bicolor.* This snout beetle has the habit of eating holes into the buds of *rugosa* and some other kinds of roses. It is about one-fourth of an inch in length and is red with a black snout. Hand-picking is the usual method of control, but in severe infestations see Japanese beetle.

Rose galls. These insects cause swellings or galls on roses. One of the galls is mosslike in appearance. Another is more corky in texture and occurs on the roots of infested plants. They do not kill the plants but only the root attacked. Control may be expected when the galls are removed and burned as soon as discovered.

Rose leafhopper, *Typhlocyba rosae.* The adults and nymphs are usually on the undersides of the leaves. On the upper side there is usually a white peppered effect that indicates the presence of the leafhoppers. All suck the sap, and severely injured leaves drop prematurely. There are two generations each season and the insect hibernates in the egg state. (See figure 132.) Perhaps the best control is to spray the undersides of the leaves with DDT or malathion as needed.

Figure 132. Rose leafhopper.

Rose leaf beetle, *Nodonta puncticollis.* The small oval, metallic greenish beetles appear in late spring and bore into the flower buds and partially open flowers. When the beetles are abundant, they also eat shot-like holes in flowers at all stages of development. The larvae may live in the soil and feed on the roots of plants. Control is not easy. Hand-picking beetles or jarring them into a container of water covered by a film of oil will help reduce the population. Beetles feeding within the buds cannot be effectively controlled. Spraying with DDT or pyrethrum may also help in reducing their numbers.

Rose leaf rollers. Several species of leaf rollers injure roses. All are the larvae of small moths belonging to the family Tortricidae. Spraying with DDT or malathion has given satisfactory control. Repeated treatments may be required if the infestation is heavy.

Rose midge, *Dasyneura rhodophaga.* This is a serious pest of roses in the greenhouse, and is known to injure outdoor roses in Canada. The small fly lays yellow eggs on the tender growth near the flower buds. These hatch in 2 days and the young larvae feed at the base of flower buds or leaf stems, causing them to become distorted and later to turn brown and die. Often there are 20 to 30 white maggots in an infested bud. The maggots mature in about a week and construct small white cocoons on the soil and a week later the flies emerge. In greenhouses only about 2 weeks are required for the life cycle and the number of generations is not known. The chief injury occurs between May and November and the flies are seldom seen during the winter. Control consists in mulching the soil in greenhouses with tobacco dust. The new growth may be inspected frequently for signs of infestation. Spraying with DDT or malathion should kill the midges before eggs are laid.

Rose sawflies. The rose sawfly, *Caliroa aethiops,* the bristly rose slug, *Cladius isomerus,* and the curled rose sawfly, *Emphytus cinctipes,* in their larval stage all feed upon the leaves of rose, some of them skeletonizing the leaves at first and later eating holes or notches in the margins. The first species has one brood and the others two or more broods each season. The remedy is to spray with DDT, malathion, or lead arsenate.

Figure 133. Rose scale.

Rose scale, *Aulacaspis rosae.* The female scale is nearly circular, flat, white, and about one-twelfth of an inch in diameter. The males are much smaller and are narrow and elongate. They suck the sap from the plant and are often numerous on the stems of rose and blackberry in sheltered situations. There are probably three complete broods each year and all stages may be found under the shells during the winter. (See figure 133.) It is best to cut out and burn the old and badly infested stems. A dormant spray of lime sulfur solution early in the spring will destroy the scales, but is not suitable for use near painted buildings because it stains the paint. Two or three sprays of malathion at 10-day intervals starting late in April should kill the crawlers.

Rose stem girdler, *Agrilus communis.* The grub of this beetle tunnels in the twigs of rose, especially *rugosa* and *hugonis,* caus-

ing swellings or galls. The twigs often break off at this point, or they die beyond the gall but do not break. The beetles appear in June and July. The larvae make spiral tunnels just under the bark, and 2 years are thought to be required for larval development. The beetle is from one-fourth to one-third of an inch long, and metallic or copper green in color.

One remedy is to clip off and burn the infested twigs in winter or spring before the beetles emerge. Spraying with DDT or malathion during June and July will kill many adults before eggs are laid.

Rubberplant

Florida red scale, *Chrysomphalus aonidum.* This is a circular, dark reddish-brown scale that stands out prominently from the leaf; the nipple is pointed; in fact, the profile of the scale is almost conical. This scale commonly infests rubber plants, palms, oleander, camellia, and citrus trees. Spraying with malathion three or four times at about 10-day intervals should be helpful in destroying the insect. Using an aerosol bomb in a greenhouse will be helpful.

Mealybugs. Rubber plants are commonly infested with mealybugs. See Chrysanthemum.

Morgan's scale. This scale resembles the Florida red scale, but is much flatter. The same treatment will control it.

Soft scale. This scale often infests the rubber plant. See Florida red scale above.

Rutabaga

See Cabbage

Rye

See Small Grains

S

Sage

Root rot, *Rhizoctonia solani.* Plants make poor growth, wilt and die. Fine roots are rotted off; larger roots have dark lesions which may be covered with brown mycelium. Soil drenches of oxyquinoline sulfate 1:4000 (see p. 5) may be helpful if plants are not too far gone.

Salsify

Tarnished plant bug. This insect sometimes injures salsify. See Celery.

Yellow woollybear, *Diacrisia virginica.* The caterpillars of this insect feed upon salsify. See Verbena.

Salvia

Foliar nematode, *Aphelenchoides* sp. Dark blotches delimited by veins affect the bottom leaves first but eventually involve the entire plants. Careful roguing of affected plant parts may be combined with soil sterilization (see p. 4) to eliminate this pest. Planting salvia in soil that has not previously had other infected or susceptible hosts is a good precautionary measure.

Shadbush (Serviceberry)

Rust. Quince-cedar rust as well as several other rusts have their aecial stage on shadbush evidenced by orange spores discharged from cluster-cups on the under surface of the leaves. Control is usually not sought, but several sprays of ferbam are effective if applied weekly starting about the time apples blossom.

Fall webworm. This insect feeds upon serviceberry. See Pear.

Gypsy moth. Gypsy moth caterpillars feed upon serviceberry. See Oak.

Roundheaded borer. This borer tunnels in the trunk of serviceberry. See Maple.

Serviceberry gall mite, *Eriophyes amelanchieri.* This mite forms small globular galls on the upper leaf surface, about one-twelfth inch in diameter, usually reddish above and light greenish yellow below. Spraying with malathion or aramite when the buds are opening in the spring may be helpful.

Small Grains

Aphids. Several species of aphids, including the English grain aphid, *Macrosiphum granarium* and the apple grain aphid, *Rhopalosiphum fitchii,* feed on small grains. They tend to cluster on the developing heads and are usually most abundant during cool springs. A number of natural enemies usually keep these aphids in check and insecticides are not ordinarily needed.

Armyworm, *Cirphis unipuncta.* The eggs of the armyworm are laid at night by brown-colored moths on the lower leaves of grasses. Populations fluctuate greatly from year to year, but seem to reach peaks when wet weather has caused dense plant growth. In such seasons considerable damage may be caused to small grains and subsequently to other susceptible crops when the caterpillars migrate into adjoining fields. Poison bran bait can be used in and around grain fields if large populations are observed. See Meadow.

Chinch bug, *Blissus leucopterus.* Both the nymphs and adults of this insect feed upon small grains as well as upon most other plants of the grass family. They are sap suckers and following the cutting of a grain crop, large numbers of the wingless nymphs migrate on foot to adjacent fields or hosts to complete development. They overwinter as adults, black with white wings bearing black markings. Although very destructive in certain areas of the country, they have not been particularly damaging to small grains in Connecticut. See Lawns.

Grasshoppers. Different species of this common and destructive insect feed on practically all kinds of plants. The damage they cause to small grains in Connecticut, however, is usually minor and special controls are not ordinarily needed. They may breed in grainfields, however, and subsequently invade and injure other crops.

Hessian fly, *Phytophaga destructor.* This insect that causes injury to wheat and to a lesser extent to barley and rye. Oats are never injured. The Hessian fly overwinters as a full-grown maggot within a brown puparium called a flaxseed. These maggots pupate in the spring after which the tiny, sooty-black flies emerge. These do not feed and live only a few days. During this time they lay

their eggs. The developing maggots do not enter the straw, but feed behind the leaf sheaths on the lower stem. Infested plants are usually stunted and frequently break over when the heads begin to fill. There are two generations a year. The best control is achieved by sowing in the fall after the adults have emerged, laid their eggs, and died.

Wireworms. These insects attack all of the small grains with oats perhaps the most resistant to injury. Wireworm larvae are the young of the familiar click beetles, and are usually smooth, hard, brown elongate forms. They feed upon the roots of host plants. There are several species and they may require from 1 to 4 years or more to complete their life cycle. They can be controlled by soil applications of chlordane or heptachlor. See Meadow.

Wheat jointworm, *Harmolita tritici.* In Connecticut this insect attacks only wheat. The adult is a small black wasp which lays its eggs inside the straw just above the nodes or joints. The developing larvae feed within the straw and cause hard, gall-like swellings to develop. Infested wheat is frequently bent or broken over at these areas. Control has not been necessary.

Snakeplant (Sansevieria)

Leaf spot, *Fusarium moniliforme.* Reddish-brown spots with yellow borders appear on one or both sides of leaves which wilt and die when girdled. Roguing of diseased leaves is indicated. Do not get water into the crown of the plant.

Wilt. Snakeplants require a low nutritional level, but when fertilizer levels are high, a burn resembling crown rot may result in top wilting. Soil and tissue tests will help determine the cause. Repotting will alleviate the condition if the burn has not girdled the crown.

Snapdragon

Anthracnose, *Colletotrichum antirrhini.* Dirty-white oval spots on stems coalesce and girdle the stems, killing the parts above the lesions. Leaves may be spotted too. Small black pustules show in the center of these spots. This is most prevalent in greenhouses in fall and spring and may be very serious. Keeping foliage and stems dry goes far toward controlling this fungus. Spacing plants so that air circulation is good is essential. Sprays of zineb at 10-day intervals may also help.

Blight, *Phyllosticta antirrhini.* A summer disease of garden snaps shows as whitish or light brown circular dots on leaves. Minute black pustules are arranged in concentric circles in the spots which may develop also on the stems. Disease is reduced by roguing and burning of all infected parts. Sprays of zineb, thiram, ferbam, or Bordeaux give good control.

Grey mold, *Botrytis* sp. Individual flowers on branches shrivel and are covered with a grey mold. Brown lesions may appear on stems. Crowding and high humidity are conducive to attack by *Botrytis.* Adequate ventilation provides better control than spray measures. A sharp drop in temperature at sundown is apt to cause moisture to be condensed on flowers thus encouraging the fungus to develop. Turning on heat one half hour before sundown prevents this condensation and the disease.

Figure 134. Rust on snapdragon.

Rust, *Puccinia antirrhini.* Chocolate-colored pustules develop chiefly on the underside of leaves, on stems, and on other green parts of the plant. Badly infected plants wilt and die suddenly both in garden and in greenhouse. Sprays of zineb or ferbam applied regularly before rust infection begins have given good control. Watering so that plant parts remain dry avoids spreading rust,

and manipulation of heat and ventilation are indicated. Use of rust-resistant varieties wherever possible is helpful.

Root rot and stem canker, *Rhizoctonia solani.* Plants wilt a little more each day, and examination of roots discloses complete rotting of fine roots. Dark lesions on the stem and larger roots may be covered with brown mycelium. Several soil applications of oxyquinoline sulfate (see p. 5) give good control of this trouble. Since a similar disease is caused by another fungus which is not controlled by the oxyquinoline sulfate treatment, *Thielaviopsis basicola,* laboratory determination is essential. Soil sterilization (see p. 4) before planting will prevent both troubles.

Stem rot and wilt, *Phytophthora cactorum.* Water-soaked lesions appear on healthy stem tissue, become yellow, then brown or almost black. Lesions enlarge and extend up and down stem until it is girdled. Plants wilt. Sprays of zineb at the first sign of the disease may give some measure of control. Soil sterilization (see p. 4) before planting is preferable.

Cyclamen mite. The cyclamen mite often injures snapdragon. See Cyclamen.

Green peach aphid. Spraying with malathion or nicotine sulfate and soap is the control.

Two-spotted mite. See Phlox.

Snowball

See Viburnum

Snowberry

Anthracnose, *Glomerella cingulata.* Cinnamon spots develop on fruit in late summer. Fruit mummifiies and drops. Several sprays of ferbam or thiram spaced 2 weeks apart are indicated, starting in mid-July.

Anthracnose, *Sphaceloma symphoricarpi.* Leaf spots appear in early spring on the leaves as small dark purple to black dots which enlarge and develop greyish centers. Purple sunken spots develop on berries. Little experimentation has been done with this disease, but repeated sprays of ferbam or zineb may be tried.

Aphids. At least two kinds of aphids infest snowberry. If abundant, a spray of malathion or nicotine sulfate and soap will control them.

San Jose scale. The San Jose scale infests snowberry. See Apple.

Snowberry clear-wing, *Hemaris diffinis.* The caterpillars of this moth feed upon snowberry and Tartarian honeysuckle, and are called hornworms because each has a horn on the tail after the manner of sphinx caterpillars. There are two broods each season and the insects hibernate as pupae in the ground. The moths emerge in May and lay eggs on the food plant; the caterpillars feed until the middle of June, when they pupate. The moths soon emerge and lay eggs for the second brood of larvae. The caterpillars vary from dark green with lighter green on the back to brown or purplish, with spiracles very prominent. The moths have a wing spread of from 1½ to 2 inches. All wings are transparent with dark brown margins. The body is black marked with golden pubescence.

Spraying with DDT, malathion, or lead arsenate late in May or early in June will control the first brood. A second treatment in July may be required for the second generation.

Soybean

Green clover worm. This insect feeds upon soybean. See Clover.

Mexican bean beetle. This insect feeds sparingly upon soybean. See Bean.

White grubs. White grubs sometimes eat off the roots of soybean. See Corn.

Spearmint

Four-lined plant bug. This bug may injure the terminal leaves of spearmint. See Currant.

Garden flea hopper, *Halticus bracteatus.* This is a small black, jumping bug which feeds upon a large number of vegetables, weeds, and ornamental plants. The female has both a long- and short-winged form. The insect overwinters in the adult stage. The green nymphs feed on the underside of leaves. This insect occurs but sporadically and control is not generally necessary. When abundant, however, DDT should give control.

Spinach

Downy mildew, *Peronospora spinaciae.* Diseased plants show yellow leaf-spots which have a purplish fuzzy growth on their undersides. These spots may quickly grow

together, killing the infected leaf or the entire plant. The fungus which causes this disease is soil- and seed-borne. It is favored by wet cool weather.

Downy mildew is not usually important on spinach in Connecticut. To avoid the disease, use clean seed, plant on well-drained soil, and use a 3-year rotation. If the disease becomes a problem do not plant winter spinach, which may carry over downy mildew from one growing season to the next.

Leaf mold, *Heterosporium variabile.* This is a disease of the older leaves. It appears as small tan leaf-spots covered with a black, fuzzy growth. It is usually not a problem in Connecticut, and may appear only after prolonged cold, wet weather just before harvest. To help avoid the disease, plant on well-drained soil and keep the plants in good growing condition until harvest.

Damping-off. This is a seedling disease which rots away the roots and base of the stem, causing the small plant to fall over and die. See Pepper.

Garden springtail. This insect sometimes injures spinach seedlings. See Beet.

Potato flea beetle. This common flea beetle feeds upon spinach. See Potato.

Spinach aphid. This aphid (also commonly called the green peach aphid), the melon aphid, and the potato aphid infest spinach. They can be controlled by dusting or spraying with malathion.

Spinach leaf miner, *Pegomya hyoscyami.* This is the most destructive insect pest of spinach. It also infests beet, chard, and the common weed called lambsquarters. There are three or four generations each season and the insect winters in the soil in the pupal stage. The adult is a gray, two-winged fly about one-quarter inch in length. It emerges in April or May and lays white cylindrical, reticulated eggs in clusters of from two to five on the underside of a leaf. They hatch in 4 to 6 days and the young maggots enter the tissue of the leaf where they make blotch mines which may involve the entire leaf. If food becomes exhausted, they migrate to other leaves. The larva, about one-third of an inch long, matures in a period that varies from 7 to 16 days. It then descends 2 or 3 inches into the soil and pupates, the flies emerging 14 to 25 days later. Best control has been obtained by early application of malathion.

Figure 135. Work of the spinach leaf miner.

Spinach flea beetle, *Disonycha xanthomelas.* This greenish-black beetle with a yellow thorax is about one-fifth inch long. It hibernates as a beetle and appears in the field in early spring when it deposits clusters of orange-colored eggs on the ground at the base of the plant. The larvae crawl to the plant and the short dirty-gray to purplish forms feed on the underside of the leaves. When disturbed the larvae drop to the ground and remain hidden until the danger is past. They enter the soil and pupate in earthen cells near the surface. Leaf miner control should also control this insect.

Spirea

Fire blight, *Erwinia amylovora.* This disease and its control are fully described under Pear.

Powdery mildew, *Microsphaera alni.* Powdery appearance of leaves indicates infection by this fungus. Sprays or dusts of sulfur give good control.

Spirea aphid, *Aphis spiraecola.* At least two species of aphids infest spirea and probably there are several others.

Spraying with malathion, lindane, or nicotine sulfate and soap is the control.

Spirea leaf roller, *Olethreutes hemidesma.* In certain seasons in August the larva of this insect webs together the leaves of the new shoots of *Spiraea vanhoutei* (and probably other spireas) and lives and feeds inside the nests. The remedy is to clip off and burn the nests, or spray with DDT or lead arsenate in July to prevent their formation.

Spirea scale, *Eriococcus borealis.* This scale sometimes infests *Spiraea thunbergi*

(and probably other spiraeas), gathering in the forks of the twigs and stems. This is a white mealy scale closely resembling the azalea scale. It may be controlled by a spray of malathion or nicotine sulfate and soap late in June or early in July. A heavy application is necessary to cover the scales.

Spruce

Canker, *Cytospora kunzeii.* Death of limb or top of tree is accompanied by excessive gumming at the point of infection. Lower limbs are more often attacked. Small black fruiting bodies may be found by cutting off bark. Cutting out of cankered area has little effect.

Figure 136. Spruce canker.

Rusts. Various needle rusts may attack spruce but usually are not serious. Aecia on needles appear as columnar white tubes which discharge orange spores. The most common rusts have leatherleaf, *Rubus* spp., and Labrador tea as alternate hosts. Control measures are usually unnecessary as conditions conducive to heavy infection seldom occur. Removal of alternate hosts around nurseries or reforested areas may be advisable.

Grey mold blight, *Botrytis cinerea.* New growth is suddenly killed, and the grey mold of spores covers dead needles during prolonged cool wet weather. Adequate spacing in nurseries and a change in weather stops this trouble.

Witches'-broom, *Arceuthobium pusillum.* This proliferation and dwarfing of tip growth is due to a dwarf mistletoe, a completely parasitic plant. It is common on black spruce but only occasional on red and white spruces. The mistletoe consists of small closely spaced projections less than three-quarters of an inch high which have rudimentary scale-like leaves and minute simple flowers in their axils. In heavy infestations the entire tree may be dwarfed. No control is known.

Aphids. One species has been collected on spruce in Connecticut, but evidently aphids are not a serious pest on spruce. Should they occur in great numbers, spraying with malathion, lindane, or nicotine sulfate and soap will control them.

Eastern spruce beetle, *Dendroctonus piceaperda.* This small bark beetle emerges in June and July in large numbers from small round holes, resembling shot holes. Weak trees of the native red, white, and black spruce in particular are infested, and the insect seems to prefer trees a foot or more in diameter. Infested trees show exuding gum more or less mixed with sawdust on the trunk. The females lay eggs in June and July and the grubs tunnel under the bark after the manner of bark beetles, hibernating in the burrows as adults and in a partially grown condition and completing their development the following spring. There is one brood each year. Infested trees should be cut, and the bark removed before the middle of May in order to prevent the beetles from reaching maturity. See also Pine, bark beetles.

Gall aphids. Several species of aphids form galls on spruce twigs. By far the commonest is the spruce gall aphid, *Chermes abietus,* that makes a pineapple-shaped gall at the base of the new growth on Norway spruce. A rather large terminal gall on blue spruce is caused by a closely related species, *Chermes cooleyi,* which spends a portion of its life cycle on Douglas fir. The spruce gall aphid hibernates in the form of immature females on the twigs near the buds. They mature in the spring and lay eggs that hatch soon after the new growth begins in May. The young attach themselves to the base of the needles and form a gall. About the first week in August these galls break open and the mature nymphs crawl to the needles. They molt and transform to sexual winged females that lay eggs on the needles for the overwintering generation. Thus there are two generations each season. (See figure 137.)

The most approved method of control consists of spraying early in April to kill

overwintering adults, using a miscible oil, 1 part in 25 parts of water, or nicotine sulfate and soap. Oil removes the bloom from blue spruces. A spray of malathion or nicotine sulfate applied soon after the new growth begins in May will give good control of the young before galls are formed.

Figure 137. Spruce aphid gall.

Gypsy moth. The caterpillars of the gypsy moth feed upon spruce. See Oak.

Spruce bud scale, *Physokermes piceae.* This insect infests several species of conifers but is especially injurious to Norway spruce. The adult scale is one-eighth inch in diameter, globular in outline, and resembles the new buds. There is one generation a year. Winter is passed in an immature condition, at the base of the terminal buds. Eggs hatch during early June and the young attack the new growth. A dormant oil spray will control the overwintering scales. Malathion spray applied when the young scales are active in mid-June will give satisfactory results.

Spruce budworm, *Archips fumiferana.* This insect has caused severe injury to spruce and balsam fir in the northern forests several times during the last 60 years. The young caterpillars feed upon the needles of the new growth of the terminal shoots and those of the preceding season, usually webbing these leaves together and eating them off at the base. The webs holding the severed leaves and bud scales give the trees a sickly appearance and in fact weaken the trees to such an extent that they become the prey of bark beetles and other secondary destroyers. The caterpillars at maturity are about three-fourths of an inch in length, and are dark brown bearing cream-colored tubercles. The adult moths have a wing spread of about three-fourths of an inch, and are brown marked with gray and white spots. They are most abundant in June and July and the females lay clusters of pale-green flat eggs upon the needles. These eggs hatch in 10 days, and the caterpillars hibernate in a partially grown condition. There is one generation each year. Mixed stands with reduced percentage of balsam fir are recommended for forest planting. Shade trees can be protected by spraying with DDT or lead arsenate late in June or early in July.

Spruce epizeuxis, *Epizeuxis aemula.* The larvae of this moth web together and feed upon the needles. The larvae are brown and covered with warts or tubercles and resemble the spruce bud worm. The moth has a wingspread of less than an inch, and is brownish gray, with both front and rear wings crossed by several narrow wavy bands or lines. A spray of DDT or lead arsenate late in August or early in September will prevent injury.

Spruce needle miner, *Taniva albolineana.* The larva of this insect as well as those of several other species mine the needles, causing them to fall in great numbers, though not noticeably defoliating the branches. Little is known about the life history. Spraying with DDT or malathion in June should control the adults. Miners may be killed by spraying with lindane or malathion early in July.

Spruce mite, *Paratetranychus ununguis.* Considerable injury is caused each season to conifers in ornamental plantings by the spruce mite, which feeds upon the leaves and webs them over somewhat after the manner of the common red spider. The trees take on a faded grayish appearance and later have a brownish cast. Dormant oil or lime sulfur sprays will kill the overwintering eggs, or summer sprays of malathion, ovotran, or aramite may be used.

Balsam-fir sawfly, *Neodiprion abietis.* The larvae of this sawfly are dark green with darker longitudinal stripes and head, and when mature are about half an inch in length. They feed upon the leaves of spruce, balsam fir, and, to some extent, pitch pine. The adult is a small black sawfly. A spray of DDT or malathion as needed in August or September will protect the leaves from injury.

Twig injury by squirrels. Often in winter spruce twigs of the preceding season's growth fall in great numbers and look exact-

ly as if they had been clipped off. This is the work of squirrels that feed upon the large terminal or lateral buds. Probably the squirrels cannot reach them without cutting and dropping them to the ground.

No remedy is known except to see that the squirrels have a supply of nuts or other food at times when it is difficult for them to find a supply of food. A spray of the repellent ZIP may be helpful.

White-pine weevil. This insect frequently infests the leaders of Norway and other kinds of spruce. See Pine.

Squash

For diseases see Cucumber

Aphids. Several species of aphids infest squash. Two of these are the potato aphid and the melon aphid. They can be controlled by dusting or spraying with malathion.

Garden springtail. The garden springtail feeds upon the young plants. See Beet.

Greenhouse whitefly. This insect also injures squash. See Tomato.

Melonworm. The larvae of this insect infests squash. See Melon.

Pickle worm. This insect also infests squash. See Cucumber.

Squash borer, *Melittia cucurbitae.* This insect is often damaging to squash. The adult moths lay eggs on the plant in late June and July, and the larva enter the stems where they live as borers. Wilted runners and vines and deposits of frass near the base of the stems indicate their presence. The larvae are white with brown heads and about 1 inch long. When mature, they leave the plant and descend into the soil. There they spin a cocoon and remain until the following spring when they pupate. There is one generation a year.

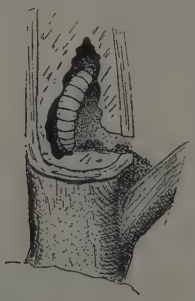

Figure 138. Squash vine borer.

Control is directed against the smaller larvae before they enter the vines and methoxychlor is used for this purpose. Spraying or dusting the last week in June and once a week during July has been effective.

Figure 139. Squash bug.

Squash bug, *Anasa tristis.* The squash bug or "stink bug" is dark brown, about five-eighths of an inch long, and hibernates in protected places. The old bugs feed upon the young plants as soon as they appear above ground and may kill them. The bug punctures the plant and sucks the sap. Later the females lay clusters of shiny brown eggs on the underside of the leaves. After hatching, the nymphs pass through five molts in 4 or 5 weeks. There is one generation per year. (See figure 139.)

Malathion can be applied when the adults are first seen and again when the young are hatching. Control is rarely necessary.

Squash beetle, *Epilachna borealis.* This ladybeetle and the Mexican bean beetle are the only two kinds of ladybeetles that injure plants in Connecticut. All of the others are beneficial and devour aphids and scale insects. The squash ladybeetle hibernates in sheltered places and emerges to lay its eggs in June on the underside of the leaves. Both adults and larvae later feed upon the leaves. The larvae usually appear about the middle of July. They are about five-eighths of an inch long, bright yellow with six rows of long, black, branched spines. The adult is dull yellow and marked with 12 black spots.

Figure 140. Squash lady beetle.

There is one generation each season. Control is not usually necessary.

Striped cucumber beetle. This beetle may damage young squash seedlings. See Cucumber.

Star-of-Bethlehem

Leaf spot, *Septoria ornithogali.* Leaves turn yellow and die with black fruiting pustules embedded in the tissue. Since the disease is infrequent, control measures have not been worked out. However, sprays of zineb or ferbam may check the disease.

Stock

Root rot, *Rhizoctonia solani.* Young plants suddenly wilt and die. Older plants wilt progressively on bright days. Flower spikes are short, and in severe infections black lesions may be found girdling the stems. Brown mycelium is generally found on these lesions and on roots. Fine roots may be completely rotted. Since other fungi can produce similar symptoms, laboratory determination is essential.

Soil drenches with oxyquinoline sulfate (see p. 5) enable plants to make new roots and keep uninjured roots from becoming infected. Several applications 3 to 5 days apart are indicated. In severe infections, additional treatments may be needed. Sterilization (see p. 4) of soil, flats, and benches usually prevents any trouble of this sort.

Damping-off. Many fungi may cause damping-off. In general *Rhizoctonia solani* can be controlled by the methods outlined under Root rot, but it is useless to make such applications unless laboratory determination of the causal agent has been made. Other fungi which may cause damping-off are *Botrytis cinerea, Pythium* sp., *Fusarium* sp., *Phytophthora cryptogea,* and *Sclerotinia sclerotiorum.* Improvement of ventilation and raising temperatures help to control the latter fungus. All may be controlled by using sterilized soil. (see p. 4)

Clubroot, *Plasmodiophora brassicae.* This slime mold causes irregular warts and lumps on the roots. These growths interfere with transit of water and nutrients from roots to leaves. Plants are generally stunted and sickly and produce no flowers. Control is difficult but is described under Cabbage.

White rust, *Albugo candida.* White pustules develop on underside of leaves. Since plants of the mustard family carry this disease, elimination of these from surrounding areas will help reduce this trouble. Sprays of Bordeaux or zineb may be helpful in preventing spread.

Bacterial blight, *Xanthomonas incanae.* Young plants up to 6 inches wilt and die. On older plants leaves turn yellow and drop, and water-soaked areas may develop at leaf scars. Pith is blackened, and badly infected plants may die. Since the causal bacteria are seed-borne, seed treatment (see p. 4) is the most effective means of control.

Mosaic. Virus. A mild and severe form of mosaic occur, involving leaf mottling, vein clearing, and distortion and curling of leaves. Color in flowers may be blotchy, and petals dwarfed. Immediate removal and destruction of affected plants is indicated.

Strawberry

Gray mold, *Botrytis* sp. The fungus causing gray mold can live as a saprophyte

Figure 141. Squash—bacterial wilt.

on the dead leaves and litter under the plants. During periods of rain or humid weather the fungus will infect any part of the plant including the green fruit. The greatest crop loss is caused by infections on the main fruit stems. Infections kill these stems and destroy the entire cluster of berries. We have found that ripe berries are not directly infected but that the infection moves into them from infected stems. The chief distinguishing characteristic of this disease is the masses of gray spores produced under moist conditions on all infected parts of the plant. According to the best information we have at present, no fungicide will satisfactorily control gray mold. Dry weather is the only sure preventative as the causal fungus does not spread under dry conditions.

Scorch, *Dendrophoma obscurans*. As the name implies this disease characteristically appears as a brown scorching of the foliage that appears most prominently just before fruit harvest, although it can be present at any time during the life of the plant. The fungus also attacks the fruit stems and spreads to the calyx lobes and fruit. It causes a hard brown rot of the fruit. On a susceptible variety such as Pathfinder, scorch can cause a complete loss of the crop in a wet season. This fungus, like the gray mold fungus, is accelerated by wet weather, but once started is not so quickly stopped by dry weather. We have found that under Connecticut conditions two applications of a copper spray or dust in September and one application after bloom the following spring will control scorch in a normal season. If there are frequent rains in the spring of the crop year, more than one treatment will be necessary.

Leaf spot, *Diplocarpon earliana*. This leaf spot is common in Connecticut and can be easily recognized by small dark lesions on the leaves and stems surrounded by a brilliant yellow or orange-red halo. Eventually large portions of the leaf turn brown and somewhat resemble scorch. The fungus may infect the berries but does not cause as severe injury as scorch. The same control program as for scorch will control this disease.

Leaf spot, *Mycosphaerella fragariae*. Another leaf-spotting disease which is commonly found on strawberries, but is not as important as the two preceding diseases. Infection by this fungus is confined almost entirely to the foliage where it produces characteristic small whitish spots with red-purple borders. No leaf-burning accompanies the foliage spotting. Many of the present day varieties are resistant to this trouble and control measures are unnecessary. The same program as outlined for scorch controls this leaf spot.

Powdery mildew, *Sphaerotheca humuli*. Mildew is usually of little importance on strawberries because it appears late in the season after the season's growth is nearly complete. Like other powdery mildews it is a superficial white powdery growth on the foliage. Occasionally it will cause some distortion of the leaves. If control seems necessary sulfur sprays or dusts are effective.

Red stele, *Phytophthora fragariae*. Red stele is a root disease most commonly found in wet spots in the field although in wet springs the disease may spread rapidly over an entire field from spores carried in the soil water. The causal fungus develops only at cool temperatures, with plenty of soil moisture, and thus does the most damage in the spring. Roots may be rotted so severely that when the fruit is developing they do not provide an adequate water supply and the plants wilt and die. Red stele can be differentiated from all the other root rots by the characteristic red-brown color of the stele or central cylinder of the root. This discoloration is readily seen by scraping off the outer part of the root. Red stele is controlled by soil applications of nabam. Our research has shown that the spread of the disease in the field can be stopped at once by one application. The nabam treatment can be used as a preventive before planting in infested soil. The red stele fungus will remain in the soil for at least 10 years and for that time it should not be planted to strawberries without treatment.

Rhizoctonia root rot, *Rhizoctonia solani*. Rhizoctonia is a common soil fungus which attacks a wide variety of plants and is not specific on strawberries as is red stele. The characteristic action of this fungus is to destroy the fine feeding roots, causing the plant to show symptoms of drought and low nutrition. The plant may not die. The infected roots show a dry, brown decay of the fleshy

part of the root, which finally is entirely disintegrated. The central cylinder remains enclosed in a tube of the root epidermis like a wire running through a pipe. Our work has shown that this root rot can be controlled by soil applications of oxyquinoline sulfate (see p. 5).

Wilts, *Fusarium* sp. and *Verticillium* sp. Besides the root diseases mentioned there are other root troubles that are not so clearly defined. Various types or strains of *Fusarium* have been isolated from diseased roots and shown to be pathogenic. The symptoms commonly associated with *Fusarium* are dark brown lesions on the large roots. These eventually involve the entire root and frequently extend as vascular discoloration in the crown. The reduction of functioning roots and involvment of the vascular system results in the wilting and eventual death of the plant during the hot weather of midsummer. High soil temperatures accelerate the activity of the fungus. *Verticillium* causes symptoms very similar to those of *Fusarium* but being more active in cool temperatures the symptoms would be expected to develop earlier in the season. Our investigations have shown that *Fusarium* is the organism most commonly found in Connecticut. Both of these organisms are wound pathogens entering through wounds or broken roots and thus could be associated with nematode injuries or root injuries at planting time. Satisfactory control measures have not been worked out.

Root knot nematode, *Meloidogyne hapla.* This nematode causes swellings on the roots. These swellings interfere with normal root functions and decrease plant growth and vigor. The knots are caused when the female nematode enters the root and becomes encysted in the tissues. This root knot nematode persists in the soil for long periods of time and becomes increasingly difficult to control with time. Whenever found prompt treatment of the area with a suitable nematicide should be made. Rotation of crops is not beneficial as the nematode is not specific on strawberry but infests a wide variety of plants.

Viruses. Virus diseases of strawberries are not well enough distinguished to warrant treating them other than as virus complexes. Neither are the symptoms well enough defined to warrant specific descriptions. Symptom expression can vary from stunted chlorotic plants to just slightly off color and vigor, or perhaps all symptoms are masked. There are no known control measures, but with the advent of virus free plants in commercial quantities the losses from virus diseases can be easily avoided. The virus-free plants are not virus-resistant and will not remain virus-free permanently.

Cyclamen mite, *Tarsonemus pallidus.* This tiny mite feeds on buds and leaves, distorting them. No practical control has been developed.

Garden millipede, *Julus hortensis.* This millipede often injures strawberry plants, especially where the crown is infested with the crown borer. See Tulip.

Spittle bugs, *Philaenus leucophthalmus.* The nymphs are recognized by the froth or spittle mass which covers them. Feeding damages both leaves and fruit. Nymphs are present only in the spring. A spray of DDT or methoxychlor applied when blossom buds first appear has controlled this pest.

Strawberry aphid, *Capitophorus fragaefolii.* This aphid transmits a virus disease of strawberry. The aphids winter over in the crowns of the plants. They develop wings in April and migrate to other plants. On newly set plants, frequent sprays of malathion may be used to control these aphids.

Strawberry crown borer, *Tyloderma fragariae.* The grubs of this snout beetle tunnel downward through the crown of the plant and by the time they are full grown the plants are severely injured. From one to three grubs may tunnel in a plant. The mature grub is about one-fifth of an inch long and is white with a yellow head. The grubs mature in July and transform to beetles within the burrow. The beetles remain there for a time and then emerge, but on the approach of winter go into the soil to hibernate. The beetles are chestnut brown in color and about one-sixth of an inch in length. They appear in early spring and the females lay eggs singly in cavities eaten in the plant near the surface of the ground. There is one annual generation. There is no remedy except to adopt the one-crop system, and to dig the new plants in the early spring before the eggs are laid, and set them some distance away from the infested beds.

Strawberry flea beetle, *Haltica ignita.* This small metallic blue or green flea beetle in early spring feeds upon the leaves of strawberry, often riddling them. It is about one-sixth of an inch in length, and the females lay eggs on the leaves of the evening primrose, upon which the larvae feed. When mature they enter the ground to pupate and hibernate, and the adults emerge the following spring. There is one annual generation. Spraying with DDT or methoxychlor will protect the foliage.

Strawberry leaf roller, *Ancylis comptana fragariae.* The two halves of strawberry leaflets are often folded and webbed together. Greenish or brownish caterpillars live and feed inside. These leaves soon turn brown and die. In severe infestations the fruit fails to mature. The adult moths appear in May and the females lay eggs singly on the underside of the leaves. The eggs hatch in about a week, and the larvae feed for about a month. When fully grown they are about half an inch in length, and vary in color from yellowish green to greenish brown with brown head. They transform to brown pupae within the folded leaves and 10 days later the moths emerge. There are probably two generations each year in Connecticut, and the insect hibernates both as a larva and as a pupa. The moth is light reddish brown with forewings marked with wavy lines of darker brown and white, and with wingspread of slightly more than half an inch. This insect can be controlled by spraying with rotenone in spring about a week after the moths first appear.

Strawberry root aphid, *Aphis forbesi.* This aphid feeds on roots. It passes the winter as a shiny egg on strawberry leaves. Ants may be partly responsible for aphid infestation. No control is known. Planting uninfested plants on clean land is the usual suggestion. Control of ants might be worth while.

Strawberry root weevil, *Brachyrhinus ovatus.* The legless grubs are white with yellow heads and about one-fourth of an inch long. They feed on the roots of strawberry plants. There is one generation a year. The adults are wingless weevils with a short stubby snout. For control, see crown borer.

Strawberry spider mite, *Tetranychus atlanticus.* These small mites can be serious pests on strawberries, especially following applications of DDT or methoxychlor. It is advisable to add Aramite to sprays of DDT or methoxychlor on strawberries to control mites.

Strawberry weevil, *Anthonomus signatus.* This weevil lays an egg in the flower bud, then eats the pedicel partly off. In severe infestations this insect may cause a loss of 50 to 60 per cent of the crop. The beetle is about one-tenth of an inch in length, and varies in color from black to reddish brown. The larva feeds almost entirely on pollen and the eggs are laid almost wholly in the buds of staminate varieties. The adult hibernates and there is only one generation each year. This insect injury may for the most part be avoided by planting a large proportion of varieties with imperfect flowers for the main crop. Some perfect flowered varieties will be necessary for pollination. A spray of DDT or methoxychlor can be used only when the blossom buds first show.

Strawberry whitefly, *Trialeurodes packardi.* This whitefly is occasionally destructive to strawberry plants. The eggs are laid on the underside of the leaves, where the nymphs remain and suck the sap. The insect hibernates as eggs attached to the leaves, and these eggs hatch in early spring. The nymphs feed for about a month, pupate, and the tiny, mealy whiteflies appear to lay eggs for another brood. The number of generations each year is not known. The worst infestations are usually in patches, rather than over the whole field. In a small garden it is possible to underspray the leaves with rotenone.

White grubs, *Phyllophaga* sp. White grubs sometimes cause severe injury to strawberry fields by eating off the roots of the plants. Sod land should be avoided. Soil known to be infested may be treated with 5 pounds of chlordane per acre before planting (10 pounds of 50 per cent chlordane), harrowed in immediately.

Strawflower

Wilt, *Verticillium albo-atrum.* This trouble usually appears when plants are about to flower. Wilting and yellowing of lower leaves progresses up the plant. Blackish-brown discoloration of the vascular system

is evident in the stem and roots. Early infection results in stunting. Soil sterilization (see p. 4), including pots or flats, prevents this trouble.

Sumac

Aphids. At least two kinds of aphids occasionally infest sumac in Connecticut. One, *Melaphis rhois,* forms a sac-like gall that projects downward from a leaflet. The opening is at the top and it is filled with immature aphids. Another aphid, *Rhopalosiphum rhois,* occurs on the underside of the leaves. Both these aphids infest the smooth sumac, *Rhus glabra.* A spray of malathion, lindane, or nicotine sulfate, applied when the leaves are opening in the spring, should control these aphids.

Mites. The flower spikes of sumac are often injured by mites that curl the leaves and form a gall. If necessary, a spray of malathion early in July may be used.

Sumac psyllids. Two kinds of psyllids or jumping plant lice are common on sumac. One, *Calophya flavida,* infests the smooth sumac. The immature nymphs are dark gray or black with narrow white fringe and may be found on the bark of the terminal twigs in winter. The adults have yellow transparent wings. Another species, *C. nigripennis,* with black opaque wings infests the shining sumac, *Rhus copallina.* Spraying with lindane or malathion when growth starts should control the pests.

Sunflower

Rust, *Puccinia helianthi.* Brownish pustules appear on lower sides of leaves which, if heavily infected, dry up and fall. Removal of infected leaves and plant debris helps check the disease.

Powdery mildew, *Erysiphe cichoracearum.* White mealy growth on leaves is indicative of this infection. Sprays or dusts of sulfur applied before infection takes place or as soon as noted will give good control.

Sunflower maggot, *Strauzia longipennis.* The larvae of this fly frequently occur in considerable numbers inside the stalks of sunflower, weakening them so that they break over. The maggots feed next to the woody stem and leave a cylindrical core of pitch detached. The fly has banded wings and belongs to the same group and feeds in about the same manner as the cherry fruit flies. The adults may be poisoned by spraying the leaves with lead arsenate, malathion, or DDT several times during the growing season.

Sweet Alyssum

Root rot and wilt, *Rhizoctonia solani.* Plants yellow and wilt. Black lesions show on stems at ground level and on roots together with a rotting of fine roots. Soil applications of oxyquinoline sulfate 1:4000 (see p. 5) made several times will give good control if plants are not too far gone.

Sweet Pea

Black root rot, *Thielaviopsis basicola.* Infected plants remain small and off-color, with rotted roots. Lesions on roots are black, and a discoloration in the stem extends up to 3 inches above the soil level. Plants do not die but never flower. Soil sterilization (see p. 4) is the only means of control for this soil-borne disease.

Root rot, *Rhizoctonia solani.* General symptoms resemble black root rot but lesions are brown and no vascular discoloration exists. The stem may or may not be girdled at ground level and covered with a brown mycelium. Plants may wilt and die. If infection has not progressed to the point where the stem is girdled, oxyquinoline sulfate (see p. 5) soil drench can be an effective aid to reestablishing the root system of the plant. Two or three applications made 3 to 5 days apart is sufficient.

Anthracnose, *Glomerella cingulata.* Whitish lesions appear on leaves, shoots, and flower stalks. Shoot tips may wilt and die with salmon-colored spore masses on the lesions. This disease may be prevented by using uninfected seed and planting in sterilized (see p. 4) or clean soil. Complete removal of all previous pea crops is essential, but soil sterilization or use of clean soil is preferable. Since the same fungus may be found on apples and privet, planting at a distance from these plants is helpful in reducing infection.

Powdery mildew, *Microsphaera alni.* White mealy growth appears on the surface of leaves and, if heavy, causes leaf drop. Repeated sprays or dusts of sulfur are best applied before mildew appears, but prompt applications as soon as noted gives satisfactory control.

Mosaic. Virus. Leaves show yellow-green mottling and curl. Flowers have short

stalks and show color-breaking. Leaf symptoms may disappear, but flowers are never normal. Since aphids transmit the disease, insect control is of prime importance for control of the virus.

Figure 142. Mosaic on sweet pea.

Spotted wilt: streak. Yellowing of leaves in zonate patterns and reddish-brown streaking on stems characterize this disease. Since thrips spread the virus, thrip control is essential. Roguing diseased plants and placing sweet peas a good distance from other susceptible hosts are indicated.

Bud drop. Physiological. This is attributed to overwatering, overfertilization, lack of light, and high temperatures. Keeping plants on the dry side and temperature below 50°F. have given some control. Artificial light may help.

Aphids. The common aphid on sweet pea is the pea aphid, but the potato aphid sometimes infests sweet pea. Spraying with malathion, lindane, or nicotine sulfate and soap will control this pest.

Corn earworm. The larvae when abundant feed upon sweet pea and many other plants. See Corn.

Greenhouse leaf-tier. This insect feeds upon sweet pea. See Cineraria.

Sweetpotato

Black rot, *Sphaeronema fimbriatum.* Tubers with this disease show irregular sunken spots, dark brown to black in color. Very often black dots are scattered across the spots. These black dots contain the spores of the fungus causing the disease. Pink masses of the spores are sometimes seen oozing from the black dots. The disease is not very troublesome on sweet potatoes grown in Connecticut. To avoid the disease choose healthy sprouts or tubers for planting, practice crop rotation, and use extra care in storage.

Soft rot, *Rhizopus nigricans.* Sweet potatoes in storage are commonly infected with the bread mold fungus, which causes a watery soft rot of part or all of the tuber. The fungus may be seen as a fluffy, white growth, with black dots supported on threads. Throw out any tubers which show soft rot, and air out the rest of sweet potatoes in a warm room.

Aphids. The green peach aphid sometimes infests sweet potatoes. See Potato.

Blister beetles. Several species of blister beetles occasionally feed upon the leaves of sweet potatoes. See Beet.

Garden fleahopper. This insect sometimes injures sweet potato. See Spearmint.

Tortoise beetles. Several species of tortoise beetles and their larvae feed upon sweet potato. These insects are shaped like a tortoise shell with a protruding edge. The more common species in Connecticut are all small colorful beetles with prominent markings or bright, irridescent color. They are generally not abundant, but can be controlled with DDT.

Sweet-william

Fusarium wilt, *Fusarium oxysporum* var. *barbatus.* Leaves hang down and edges may curl inward before plants yellow and die. The vascular system shows brown discoloration. Planting in sterilized (see p. 4) or clean soil is most effective control.

Swiss Chard

See **Beet**

Sycamore (Planetree)

Anthracnose, *Gnomonia veneta.* Dark blotches follow veins on leaves, causing a crisping of lobes and leaf drop. The same fungus causes a similar condition on white oaks and overwinters on fallen leaves and small branch cankers on both hosts. This disease is very common but not fatal. Trees seem to survive infection year after year and replace fallen leaves with new ones.

Sprays of ferbam, thiram, or Bordeaux applied when buds burst, when leaves are half grown, and when full grown give good control. Removal and burning of infected wood and fallen leaves together with fungicidal sprays on sycamore and nearby oaks are indicated.

Aphids. A large gray aphid, *Longistigma caryae,* is found on the bark and twigs of sycamore. A malathion spray will control it.

Sycamore lacebug, *Corythucha ciliata.* This lacebug is very common on the underside of the leaves of sycamore. On the upper surface the usual white-peppered effect indicates where this bug has sucked the sap. The adult bugs hibernate under the edges of the bark and other places where they can find protection. Soon after the leaves unfold, the bugs emerge and lay eggs on the underside of the leaves. The eggs hatch, and the nymphs pass through five stages and become adults in a little more than a month. It is not known how many generations there are in a season. Spraying with DDT, malathion, or nicotine sulfate and soap twice in the spring will control this pest on shade trees.

Sycamore leaf folder, *Ancylis platanana.* The caterpillar of this little moth folds the leaf and feeds in the fold, chiefly along the midrib near the base of the leaf. The adult has a wing spread of about half an inch and is dull orange in color with darker, wavy bands. Spraying shade trees with DDT, malathion, or lead arsenate will control this pest.

Terrapin scale. See Maple.

White-marked tussock moth, *Hemerocampa leucostigma.* The caterpillars of this insect feed upon sycamore. See Horsechestnut.

T

Taxus

Root rot and damping-off, *Rhizoctonia solani.* In the cutting bench lower needles yellow and drop, and the brown heavy mycelium can be seen on the stem at, below, and sometimes above ground level. (Not to be confused with *Botrytis,* the gray mold.) In lining out stock, symptoms resemble drouth injury, and trees can be completely killed. On older trees slow growth and discoloration of tips of needles follow a rotting of fine roots and brown lesions on larger roots that are covered with brown mycelium. Soil applications of oxyquinoline sulfate 1:4000 (see p. 5) have quickly checked dying of trees. Two or three applications spaced a week apart are more successful if infection is severe.

Black vine weevil, *Brachyrhinus sulcatus.* The larvae of this snout beetle often injure Taxus plants in nurseries and ornamental plantings by feeding on the roots. The grubs devour the small roots and gnaw the bark from the larger roots, often girdling them. The tops first turn yellow and later brown and the severely injured plants die. The adult is a snout beetle nearly half an inch in length, dark brown or black in color, marked with scattered spots of light brown pubescence. The grub is dirty white with dark head, without legs, and is curved like grubs of other weevils. Treating the soil with dieldrin, endrin, or chlordane will control the larvae. Spraying with DDT during June and July should be helpful in controlling the adults. See Circular 174.

Catalpa mealybug. See Catalpa.

Scale. See Arborvitae.

Two-spotted mite. See Phlox.

Tobacco

Diseases in the seedbed. Diseases occurring in seedbeds are discussed in detail in Circular 175 of this Station.

Black root rot and brown root rot. Pale-green plants are stunted, stand is reduced, and growth of plants in the affected area is raggedly uneven. Plant roots may have blackened areas caused by the fungus *Thielavopsis basicola* or roots may have intermittent browned areas caused by feeding of meadow nematodes *(Pratylenchus* species). Control is achieved by steam or chemical sterilization of the soil.

Early damping-off. This disease causes a loss of stand. Close inspection shows that newly emerged plants rot at the soil line, topple over, dry up and disappear. Seedbed sterilization with formaldehyde before seeding kills the causal fungi, *Pythium* and *Rhizoctonia.* The soil is easily reinfested.

Wildfire. This bacterial disease produces a distinct yellowish halo around a small dead spot on leaves. On very young plants the quarter-inch diameter halo may be larger than the leaf itself, causing confusion of the disease with damping-off. Large patches of plants may die or remain severely stunted. Spread is rapid, hence the name wildfire. Sprays of Bordeaux mixture or neutral copper compounds, applied weekly from the cotyledon stage until the leaves are the size of a dime, control the disease. Copper does not control blue mold or bed rot and may injure plants when used with dithiocarbamate sprays. Recently streptomycin compounds have been found effective against wildfire and they do not cause injury when used with dithiocarbamate materials.

Blue mold and bed rot. Blue mold and bed rot appear after seedlings begin crowding each other. Plants the size of a quarter or larger begin dying in widening patches. If blue mold is present the leaves become pale and lower leaf surfaces show a bluish fuzz. This fuzz releases spores of the causal fungus *Peronospora tabacina* which spread on air currents and cause new infections. If bed rot is present the causal fungi, species of *Pythium* and *Rhizoctonia,* may rot the plant stems near the soil causing plants to wilt and collapse. The disease may also travel from leaf to leaf causing a wet slimy mass of rotten plants. Nearly complete control of both diseases has resulted from biweekly sprays with the dithiocarbamate chemicals zineb, ferbam, and maneb when used according to directions on the package labels. Streptomycin compounds have given excellent control of blue mold but do not control bed rot.

Yellow patch. Patches of plants turn yellow, stop growing, and may die out. The roots are brown but are free of fungi or nematodes. High levels of ammonia nitrogen cause the trouble and burn the plant roots. Plants will normally recover if the affected areas are sprinkled with a solution of 2 pounds of cacium chloride or potassium chloride in 100 gallons of water applied 1 gallon to a sash. Fall steaming of the beds, or avoiding high amounts of organic nitrogen before spring steaming, greatly reduces the chance of ammonia injury in the beds.

Diseases in the field

Transplant rot. Week-old transplants fail to grow or suddenly collapse. Rotting of the stem just below the soil line appears as a wet decomposing slime or as a withered string of tissue. When stems are partially hollow, insect injury has preceded the rot. The causal fungi, *Pythium* and *Rhizoctonia,* may first attack the plant as bed rot in the seedbed. Thus control of bed rot reduces the danger of transplant rot. Toughening plants in the seedbed by removing the sash completely and watering sparsely for 1 week or more before setting reduces the chances of direct infection after transplanting.

Black root rot. Root troubles in general are indicated by stunted plants, irregular growth, and a ragged appearance to the field. Black root rot causes roots to have blackened areas along them with many stubby black ends. The symptoms are most severe when the soil pH is over 5.5 but they may occur in soils as low as 4.9. Thus, lowering the pH of a field usually reduces the disease but does not always do so. Resting the land from tobacco for 2 or 3 years is the most effective control. Fields with a cold wet soil are prone to black root rot. Planting them late may help. Resistant varieties of tobacco are constantly under development, since the fungus gradually adapts itself to the resistant strains.

Brown root rot. This disease results in part from the feeding of several species of nematodes *(Pratylenchus* and *Tylenchorenchus).* The above-ground symptoms are much the same as for black root rot. Roots have brown blotches at intervals or may have a completely brown and rotted outer shell. Microscopic nematodes can be found in the roots early in the season but they later disappear. Control is achieved by fumigating the soil with ethylene dibromide or a dichloropropane-propene mixture. Some fields require yearly or semi-yearly treatments. Others need treatment only every 5 years. Corn or grasses usually increase nematode numbers and therefore increase disease severity of the disease.

Sore shin. This disease is a form of transplant rot or bed rot occurring on older plants. Stalks develop a cankered area near the soil line or may be completely girdled just below the soil by a blackish collar. First notice of sore shin may be when plants topple over in a strong wind. Mechanical injuries to the stalk help start the disease. Some fields tend to produce sore shin regularly and can be avoided. Plants that have survived slight infections of bed rot as seedlings often develop sore shin later. Thus control of sore shin depends on control of bed rot.

Blue mold. In some years blue mold is also important in the field, particularly on shade-grown tobacco. Areas of the leaf from one-half to one inch in diameter begin to pale, turn a watery gray and then brown. When dry, the dead tissues may fall out and leave holes in the leaf. On stalk tobacco blue mold does not appear to spread from plant to plant in the field. However, there have been many cases where an acre or more of stalk tobacco adjacent to neglected seedbeds has been severely damaged. Control measures on stalk tobacco are primarily to keep the seedbeds sprayed semi-weekly with zineb, ferbam, or maneb until all need for plants is past, then destroy them with a 1 to 50 solution of formaldehyde in water.

On shade tobacco blue mold spreads from plant to plant in the field. Thus the application of a 16 per cent zineb fungicidal dust twice weekly during June and July in years when blue mold is present and likely to spread is indicated for shade tobacco. Recently blue mold outbreaks have been successfully forecast a week in advance, thus permitting growers to apply zineb dust closer to the time of actual danger. Since the disease originates in seedbeds, control of the disease there is important.

Mosaic (calico, brindle, gray top, white rust and red rust). Young leaves are usually distorted and show various degrees

of pale-yellow and intense dark-green mottling. Older leaves develop both white and brown dead areas that resemble rust. The newest growth on the plant usually shows the most severe symptoms of distortion and stunting. The virus is extremely persistent and can be carried in chewing and smoking tobacco, on hands, implements, and clothing, and in the soil on plant debris. The disease spreads readily from infected plants to healthy ones when handled during cultural operations. Control measures are based on sanitation to avoid successive handling of infected material and healthy plants. Avoidance of smoking or chewing tobacco around seedbeds or when transplanting has proven helpful in reducing infection. Elimination of infected plants is also indicated, with suitable care to avoid contact with healthy plants. Washing the hands thoroughly with strong soap after handling infected plants eliminates the chance of further spread by handling. Resistant varieties of Connecticut tobacco types are under development.

Wildfire. In the field as in the seedbed, wildfire is distinguished by a characteristic yellow halo around a small dead spot. Often one form of the causal bacteria produces an angular spot delimited by the leaf veins. As the spots get older and tissue drops out it becomes hard to find the halo or the angular characteristic. The disease is spread mainly by wind and rain. An entire crop can be lost in stormy seasons. Spread in the field results from plants that were infected in the seedbed. No control measures are available for use in the field, but the disease can be prevented by setting only disease-free plants in the field.

Fleck. Fleck is a disease of unknown cause. Very small necrotic spots appear in an irregular pattern on the upper surface of the leaf. In severe cases large dead areas may occur. Leaves become affected from the bottom of the plant upwards as they approach maturity. New areas of the leaf become mildly affected in rather sudden spurts. This generally occurs after hot-weather rains. The spots in these affected areas gradually enlarge with time but do not spread to unaffected areas. Losses in the last few years have been greater from this disease than from any other trouble on shade tobacco. Strains differ in susceptibility and there is hope for the development of a resistant, commercially acceptable variety.

Diseases in the curing barn

Pole rot or pole sweat. As tobacco cures in the barn the tissues become more and more susceptible to decay by fungi and bacteria. Symptoms of such decay may appear in the shed as a slimy rot on the stalk where the leaf attaches, causing the leaf to fall. In other cases the stalk dries out too soon and the leaves cure out thin, papery, and of poor quality. The leaves themselves may develop a soft rot on the blade or along the veins. Often these soft tissues are not noticed until the tobacco is handled in sorting. A number of fungi are responsible for this serious disease. Among them are *Sclerotinia sclerotiorum, Botrytis cinerea* and *Alternaria tenuis.* All require high humidity for development. Pole rot is controlled by keeping humidity low during curing, by loose spacing of the tobacco, and by good ventilation of the sheds. In damp, muggy weather it is often necessary to add extra heat to dry out the air around the tobacco. Use of charcoal fires or the more convenient gas burners using liquified petroleum is effective for this purpose. In general the temperature inside the shed should not be more than 15 degrees above the temperature outside. Green firing to wilt newly hung tobacco more quickly serves as insurance against pole rot later on.

More detailed information on the diseases discussed in this section is available in Bulletin 564 of this Station.

Aphids. The green peach aphid, *Myzus persicae,* has become an annual pest of tobacco. This light green species may infest plants in the seedbed and be carried into the field. Infestation may also occur when winged aphids fly to tobacco plants. Spraying plants in the seedbed with malathion should prevent transfer of aphids to the field. Malathion may also be used to control outbreaks in the field. See Circular 191.

Cranefly maggots. Tobacco is occasionally injured by cranefly maggots, *Nephrotoma ferrugina.* The maggots, called "leather jackets," eat notches in the stems near the surface of the ground, causing some of the plants to break over, and all injured plants are ruined for crop production purposes. The maggots are about an inch long, gray, leathery in texture and have four protuberances on the head. The adults are two-winged flies with very long legs. Control has been difficult because infestations cannot be forecast.

Addition of chlordane wettable powder to the setter water should be helpful.

Cutworms. Tobacco plants are often severely injured by cutworms soon after the plants are set in the field.

Plants are cut off near the ground, and the injury can be prevented by distributing poisoned bran mash over the field a few days before the plants are set. After the plants have grown to a height of 12 to 18 inches, climbing cutworms sometimes devour portions of the leaves. Use of commercially prepared toxaphene bait has been very effective. Three pounds of toxaphene or chlordane per acre applied as dusts to the surface of the soil 5 days before planting, and left undisturbed, gave effective control. See Circular 191.

Garden springtail. The garden springtail often injures young tobacco plants in the seed beds. See Beet for description. If control is necessary, a malathion dust may be applied lightly to dry plants in the seedbed.

Grasshoppers. Several species of grasshoppers feed upon the leaves of tobacco and the injury is usually more severe around the margins of the field. A light dusting of plants at the edges of the field, using endrin, should control grasshoppers. Heavier applications can be made to waste areas around fields to kill the grasshoppers before they attack the tobacco.

Greenhouse whitefly. This insect sometimes infests tobacco in fields adjacent to a greenhouse or dwelling, where it can live through the winter. Control is usually unnecessary.

Potato flea beetle. This insect is responsible for nearly all the flea beetle injury to tobacco in Connecticut. Spraying or dusting with DDT when beetles appear has controlled this pest. If DDT-resistant flea beetles occur, dieldrin, endrin, or heptachlor may be used.

Seed-corn maggot. The seed-corn maggot, *Hylemya cilicrura,* sometimes injures tobacco plants by entering the stems just below the surface of the ground. Sometimes only a pinhole is visible, but often a larger injury is apparent. Several maggots may be inside the stalk, perhaps hollowing it out. Such injury occurs on land where clover was grown the preceding year and turned under. No practical control is known other than to avoid planting tobacco on clover sod. See Corn.

Stalk borer. The stalk borer is often a pest of tobacco. Control is usually not required. See Dahlia.

Figure 143. Tobacco hornworm.

Tobacco hornworms. The tobacco worm, *Phlegethontius quinquemaculata,* is the more common hornworm in the tobacco fields of northern Hartford County, but the tomato worm, *Phlegethontius sexta,* is the more common in the region between Southington and New Haven. They cause identical injury and closely resemble each other, and the caterpillars of both devour the leaves of tobacco and tomato wherever these plants are grown throughout the State. The caterpillar reaches a length of about 4 inches and is nearly as large as one's finger. Usually green, the caterpillar has whitish oblique bands along each side and a sharp-pointed horn on the back at the hind end. The insect hibernates in the ground as a naked brown pupa, about 2 inches long, with a tongue case bent downward on one side. This tongue case or "jug-handle" is longer in the tobacco worm than in the tomato worm. The adult is one of the sphinx moths, also called hawk moths and humming-bird moths, that have large heavy bodies and long narrow wings. They fly at twilight and poise in the air to sip nectar from deep-throated flowers in the manner of a humming-bird. The wingspread is from 4 to 5 inches and the forewings are ash gray marked with many narrow, darker and light-

.er, wavy lines. The rear wings are whitish with dark gray outer margins, and are crossed by four black wavy or zigzag bands. The abdomen on each side has a row of large orange spots margined with black. The head, thorax, and abdomen as seen from above are gray with black and white markings, and the orange spots on the sides of the abdomen are also conspicuous. The moths appear in June and lay eggs singly on the leaves. The eggs hatch in from 3 to 8 days and the caterpillars reach maturity in about a month. There is probably only one generation in Connecticut. (See figure 143.)

Application of 10 pounds of 10 per cent TDE (DDD) dust per acre controls hornworms.

Wireworms. Wireworms are the larvae of "click beetles" of the family Elateridae. The adult beetles are usually flat, elongated, and narrow, and black or brown. The larvae are yellow, orange, or brown, hard, shiny, and slender. Many different kinds cause injury to plants. They have different life histories varying from 2 to 6 years for the complete life cycle. One of the more destructive species is the Eastern field wireworm, *Limonius agonus*. Treatment of the soil by application of an insecticide which is immediately disced in has given good control of wireworms. For this purpose 4 to 6 pounds of chlordane or 2 to 3 pounds of aldrin or heptachlor per acre have been effective. The higher amounts are required on heavier soils. Treatment is usually needed only once in 3 years.

Tomato

Late blight, *Phytophthora infestans*. Leaf symptoms of late blight are irregular, dark, water-soaked areas, covered on the underside by the frosty-white spores of the fungus which causes the disease. Fruit infections show as peppery red-brown, firm areas, usually near the stem end of the fruit. The discoloration is usually only skin-deep.

In most years, late blight is not serious on tomatoes in Connecticut except on late-crop tomatoes. It is greatly feared, however, because of the rapidity with which it spreads, and may destroy whole crops. The spread of the fungus is favored by cool, wet nights and warm, humid days. The disease also attacks potatoes. The fungus carries over from season to season in potato cull piles, or in compost heaps containing old potato or tomato debris.

Many materials give protection against late blight if properly applied. Some of these fungicides are zineb, nabam, dichlone, inert coppers, and Bordeaux (8-4-100).

Ordinarily, spraying for late-blight control would begin in the first part of August. The time to begin, however, is when there is a period of weather favorable to the fungus. Such a period may take place anytime during the growing season. Spraying may be stopped during hot, dry weather.

The Connecticut Agricultural Experiment Station and the Extension Service in cooperation with the U. S. Department of Agriculture keep the public informed of outbreaks of late blight in neighboring states. Each year the first identified late blight in Connecticut is also publicly reported. These reports help growers of tomatoes decide when to start spraying.

Early blight, *Alternaria solani*. The loss from this fungus disease in Connecticut during an average year is probably greater than the loss from late blight. The disease begins as circular, brown target-spots on the leaves. These spots are usually ringed with an irregular area of yellow. Infected leaves eventually turn yellow and fall off. In bush tomatoes the top and center leaves of the plants are most severely infected. Foliage infection usually takes place and becomes noticeable just when the first heavy set of fruit is starting to develop and ripen. Fruit infections are usually not numerous. They appear as brown target-spots, similar to those on the leaves. The main damage from early blight is the loss of much foliage. This foliage is needed to produce the food which goes into the developing fruit. This makes for small, poor quality fruit. Loss of leaves also exposes developing fruit to the sun, resulting in sunscald.

Early blight very often attacks seedlings in cold frames during periods of overcast skies and cold weather. Seedlings usually recover from the attack as soon as the skies clear.

Some of the fungicides used for the control of late blight are effective against early blight. These are zineb, nabam, maneb, and dichlone. The copper sprays are not effective against early blight. Ziram is one of the best fungicides for the control of early blight, but is not good for protection against late blight.

The early-blight fungus can survive in seed as well as soil. To help avoid the disease it is best to use clean seed, and practice crop rotation.

Anthracnose, *Colletotrichum phomoides.* This disease appears as small, flat, circular, shiny, dark spots on the ripening or ripe fruit. These spots are fairly soft and serve as wounds for the entry of other rotting organisms which may destroy the whole fruit.

The fungus causing this disease may infect the fruit any time from the green stage until harvest. Because the symptoms are not prominent until the fruit ripens, many growers do not become concerned about anthracnose until it is too late to prevent infection. To protect against anthracnose, spraying should start at the green-fruit stage. Many fungicides are good protectants against anthracnose. Some of these are ziram, maneb, and nabam. Copper sprays are not adequate for controlling anthracnose. Anthracnose, like early blight, is both soil- and seed-borne. Use clean seed and practice crop rotation.

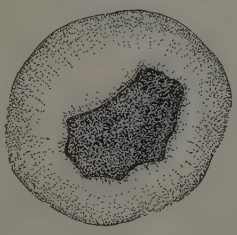

Figure 144. Blossom-end rot on tomato.

Blossom-end rot. Tomato varieties susceptible to this injury develop brown to black, irregular, sunken areas around the blossom-ends of the fruits. This is supposedly caused by a period of cool wet weather during rapid fruit development, followed by hot, dry days. The injury is not caused by any microbe. It is apparently brought about by the foliage robbing water from the soft, rapidly developing fruit end. This causes the robbed fruit tissue to dry and collapse.

Pritchard and Marglobe are resistant, while Rutgers and Valient are susceptible. Spraying with a very dilute solution of calcium chloride will help prevent blossom-end rot.

Fusarium wilt, *Fusarium lycopersici.* Older leaves of diseased plants turn down and become yellow. Other leaves follow suit, and the whole plant may be killed. If the plant survives it is usually stunted and the fruits are small, few, and poor in quality. Scraping the stem near the ground reveals a dark discoloration. The disease is caused by the fungus *Fusarium,* which lives in the soil and infects plants through the roots. The fungus grows up through the roots into the stem.

The fungus is favored by high soil moisture and warm temperatures. It may be particularly serious in greenhouse tomatoes. It has been found in Connecticut tomato fields, but is usually not too important out-of-doors. No sprays protect against Fusarium wilt. It may be avoided in the greenhouse by soil pasteurization, and the use of resistant varieties. There are available both greenhouse and field types resistant to Fusarium wilt.

Mosaic diseases. Mosaic infected plants show leaf mottling which may vary from light green on dark green, to yellow on light green. The leaves may be very twisted and deformed. Narrow "shoestring" leaves are sometimes produced. Dead streaks occasionally show along the stems and petioles. The plants may show various degrees of stunting. Fruits are often small, knobby, misshapen, and may show mottling. Plants infected early in their development may be a total loss. Plants infected later in the season may produce an adequate crop if they are given extra fertilizer.

Mosaic on tomatoes is caused by a number of viruses. Any virus may produce disease, either alone or with other viruses. The viruses which attack tomatoes also attack a great number of other crops and weeds such as tobacco, cucumber, pepper, ground-cherry, horse-nettle and nightshade. Certain of the viruses may be spread by aphids or by handling first infected plants and then healthy plants. Infectious amounts of virus have been found in smoking and chewing tobacco. To avoid mosaic, keep down weeds around tomato fields, control tomato insects, particularly aphids, and do not use tobacco when handling tomato plants. Remove and destroy mosaic-diseased plants from seedbeds and fields.

Internal browning. Tomato fruits with internal browning have grayish discolored blotches on the skin. When these fruits are

cut, they show brown, collapsed spots in the wall and flesh. There is some question about the actual cause of internal browning. The latest information indicates that the symptoms are a "shock" reaction caused by infection of the plant with mosaic viruses just as the fruits are developing. The symptoms may appear on only one fruit of the set, or on one or more sets. Cold, wet weather favors the appearance of symptoms. Warm, dry weather tends to prevent the symptoms. Fertilizing with high-potash fertilizers tends to reduce the disease.

No fungicidal sprays will control internal browning. To reduce the chances of getting the disease, use the control measures suggested in the preceding section on mosaic diseases.

Growth cracks. These circular, concentric rings appear around the stem-end of the fruit. They are not caused by any microbe, but are brought about by weather conditions, or poor fertilization practice. Growth cracks supposedly arise in the following way. Fruit growth slows down because of drought, cool weather, or lack of fertilizer. Suddenly there is a rainstorm, or warm weather, or the plants are side-dressed with extra fertilizer. Whatever the cause, the fruits start to grow more rapidly than their skins will allow, and the growth cracks appear. When the change in growth rate is too sudden, the fruits may actually split. Growth cracks and splits may serve as wounds for the entry of fungi and bacteria which may rot the injured fruit. To avoid growth cracks and splitting, see to it that the plants get a fairly uniform supply of water and fertilizer.

Root knot. Infected plants appear stunted and sickly. The fine roots are knotty, and have elongated overgrowths. This disease is caused by microscopic eelworms, called nematodes, which infest the soil. These nematodes invade the fine roots, feed on the plant juices, and lay their eggs within the tissues of the roots. This activity causes the plant to produce the root knots, and interferes with normal functioning of the infected roots. Eventually the roots decay, badly damaging the diseased plant, and release the nematodes into the soil.

Besides tomatoes, root knot nematodes may attack many other plants including carrots, cucumbers, parsnip, strawberries, tobacco, snapdragon, aster, begonia, cyclamen, gardenia, primrose, and rose. The number of root knot nematodes in soil is greatly reduced by severe winters. In the past, root knot nematodes have been chiefly a greenhouse pest. The recent mild winters have allowed them to build up out-of-doors, and, nematode root knot has become more common on field-grown carrots and strawberries.

To avoid the disease, start seedlings in sterilized soil. When buying transplants, examine the roots to make certain they show no root knots. Do not plant susceptible crops in an area with a past history of nematode root knot.

2,4-D injury. Tomato plants which have been exposed to 2,4-D have twisted, downward-curled leaves, and zigzag stems. New growth of such plants is usually stunted and deformed. The youngest leaves appear pulled out of shape and show deformed veins. If a 2,4-D–injured plant produces fruits, they are usually small, oval, and seedless.

Tomatoes are extremely sensitive to 2,4-D. The ester form of 2,4-D is particularly volatile and most likely to cause injury if used anywhere near tomatoes. The amine and salt forms are less volatile. The best practice is not to use 2,4-D around such sensitive vegetables as tomatoes or beans. If 2,4-D is used, do not open the container, or mix the spray, near growing vegetables. Spray only on very quiet days, and keep the spray nozzles low. 2,4-D is very hard to clean out of a sprayer. If a sprayer is once used for 2,4-D, do not use it for applying anything to vegetable plants.

Leaf rolling. During the first hot days of summer the edges of the lower leaves often will roll upward. This upward leaf-rolling is supposedly caused by sudden hot weather after a period of lush growth. The symptom is usually most prominent on staked tomatoes. Leaf rolling is temporary and causes no damage to the plant or crop.

Damping-off. Seedlings rot off at the level of the soil, fall over and die. See Pepper.

Aphids. The potato aphid and the green peach aphid both commonly infest tomato plants. They can be controlled with malathion. See Potato and Spinach.

Blister beetles. In some seasons, large, slender, soft-bodied black or gray blister beetles may cause some damage by feeding

on tomatoes. Ordinarily, no treatment is desired, but they can be controlled by pyrethrum or methoxychlor if necessary. See Beet.

Colorado potato beetle, *Leptinotarsa decemlineata.* Adults and larvae of the Colorado potato beetle occasionally feed on tomatoes. They can be controlled by dusts or sprays of rotenone or methoxychlor.

Stalk borer, *Papaipema nebris.* The eggs of this caterpillar are laid in the fall by the moths on grass and weeds in hedgerows, waste fields, etc. After hatching in the spring the borers feed on grasses and weeds and later may migrate into adjacent tomato fields where they cause injury. The caterpillars are very active. Their restless habit of frequently changing from one plant stem to another increases the damage. If abundant they can be controlled by treating the stems and the soil around and between the plants with methoxychlor.

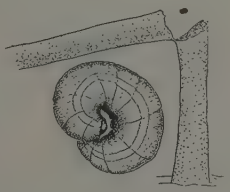

Figure 145. Cutworm

Cutworms. Perhaps 14 or 15 species of moths, the larvae of which are called cutworms, feed on tomato. All belong to the family Noctuidae, and all are somber-colored moths. In most cases the larvae feed at night and remain just below the soil surface during the day. Most of these cutworms reach a length of 1 to 2 inches. They are smooth, naked caterpillars, dull gray, greenish or brownish in color, indistinctly marked with spots and longitudinal stripes. Some have one generation each year and others have two or more, but most of those that are troublesome in the field are probably of the single-brood type that hibernate as partly grown larvae. Most of these commonly feed on grasses and weeds, but will feed upon a variety of plants when cultivation or other causes destroy their regular food supply. A few species are able to travel across large plowed fields to find food.

They can be controlled by distributing poison-bran mash about the field in the evening or by treating the soil at the base of the plants with DDT or heptachlor. If only a few plants are involved, wrapping the stems with paper is a practical remedy. (See figure 145.)

European corn borer. This borer may occasionally attack tomato. Infestations usually occur when tomatoes are planted next to early corn and the borers migrate from the dying corn to the succulent tomato vines. See Corn.

Garden springtail. This tiny insect may injure young tomato seedlings. See Beet.

Greenhouse whitefly, *Trialeurodes vaporariorum.* This whitefly commonly infests tomato, as well as many other kinds of plants, under glass and is often carried into the field where it may persist on the plants. The tiny, white moth-like adult has a mealy appearance due to the small particles of wax that it secretes. It lays groups of eggs on the underside of leaves. The eggs hatch into small oval larvae that suck sap from stationary locations on the leaves. About 5 weeks are required to complete the life cycle in the greenhouse. A spray of malathion or nicotine sulfate and soap directed against the underside of the leaves should control this insect in the greenhouse or the field.

Potato flea beetle. This small, black, active beetle feeds chiefly on the underside of the leaves and may damage the foliage. Injury is usually most severe to newly set plants early in the season. See Potato.

Tomato fruitworm, *Heliothis armigera.* The tomato fruitworm, known as the corn earworm when it attacks corn, occasionally feeds on the fruit of tomato. The caterpillars are restless and frequently move from fruit

Figure 146. Greenhouse whitefly.

to fruit, thus damaging many while not consuming a single one. The variegated cutworm, a species of climbing cutworm, may also attack the fruit in a similar manner. They have been controlled by treating with TDE, DDT and methoxychlor.

Tomato hornworm, *Protoparce quinquemaculata.* The larvae of this insect and that of the tobacco worm, often feed upon the leaves of tomato. When fully grown, this larva is about 4 inches long, green with oblique whitish bands along each side and a horn on the tail end of the body. The adult moth is similar to that of the tobacco worm except that the forewings have a mottled gray-brown appearance, and are somewhat darker in color. The wing spread is between 4 and 5 inches. The caterpillars can be controlled with rotenone when small. TDE has been very effective against the larger ones. It is also convenient to handpick the larger worms when only a few plants are involved.

Trumpet creeper

Mealy flata. This insect sometimes occurs on trumpet creeper. See Lily.

Trumpetvine

Leaf spots, *Cercospora sordida.* Leaf spots are reported to be caused by several fungi but are not serious except under exceptional conditions; in which case sprays of ferbam, thiram, or Bordeaux are indicated.

Figure 147. Tulip fire.

Tulip

Fire, *Botrytis tulipae.* Spotting and collapse of tulip leaves, stems, and flowers is usually accompanied by the brown-grey mold of the fruiting stage of the fungus. Tiny black sclerotia carry the fungus in the bulbs and in the soil. The disease may be spread by windblown spores from infected plants. Once infected, the removal of the entire plant is indicated. Careful inspection of new bulbs before planting in clean or sterilized soil (see p. 4) goes a long way toward elimination of the trouble. If outer husks are removed, yellow diseased spots show clearly. The sclerotia remain viable for a long time in the soil, so that replanting without sterilization usually results in infection.

Figure 148. Breaking on tulip.

Breaking. Virus. In normal flowers color is uniform except at the base of the flower. Variegated flowers with stripes or streaks of another color are the result of virus infection. Virus infected leaves are distinctly mottled, and size and production of bulbils are reduced. Parrot tulips are the result of systemic virus infection.

Since aphids can transmit the disease, separation of parrot and bicolored tulips from solid-color flowered plants is as important as insect control.

Grey bulb rot, *Rhizoctonia tuliparum.* Early infection shows as retarded growth resulting eventually in bare spots in the tulip bed. (Mice also cause bare spots.) Black sclerotia under the husks of infected bulbs perpetuate the fungus indefinitely.

Control is by selection of clean bulbs, planting in sterilized or clean soil (see p. 4) and removal and destruction of all infected plant parts.

Topple. Flower stalks collapse with no visible injury. Topple has been reported also

on iris and glads. Recent work indicates that it may be caused by a calcium deficiency. Foliage sprays of a 2 per cent calcium nitrate solution have given control of this trouble. A spreader is advisable to enable the material to penetrate the plant tissue.

Aphids. The tulip aphid, *Anuraphis tulipae,* is perhaps the most common and most troublesome aphid on tulip, and is more apt to cause injury on forcing bulbs than out-of-doors. It also winters on stored gladiolus corms. Soaking the bulbs or corms for half an hour before setting, in nicotine sulfate, 1 part in 800 parts water with soap, or in pyrethrum-soap will kill the aphids. Immersing the infested bulbs or roots in water at a temperature of 110° F. for 30 minutes will destroy the insects. Infested bulbs may be dusted with a malathion or nicotine dust for effective control. Exposure to the treatment should last for several hours before the bulbs are planted or returned to storage. Hydrocyanic acid gas fumigation is also useful. A temperature of 70° F. should be maintained during fumigation.

Bulb fly. This insect infests tulip. See Narcissus.

Garden millipede, *Julus hortensis.* These millipedes frequently attack the bulbs in tulip beds, especially in old beds where the bulbs are not reset each year. They eat into the bulbs and the mutilation is followed by decay. Sometimes all the bulbs are destroyed. When abundant, these millipedes also injure other bulbs, strawberry plants, and the roots of various other plants. Tulip bulbs may be dug after flowering, kept cool and dry, and planted in the fall. Treating the soil with dieldrin or chlordane will be helpful in controlling the pest. Dusting the surface of the ground with either of these insecticides will also give satisfactory control.

Tuliptree

Sooty mold, *Capnodium elongatum.* Leaves and/or twigs appear black from this mold which grows on the honeydew secreted in great quantities by aphids and the tuliptree scale. In itself sooty mold is not injurious. Control of insects eliminates the honeydew and the mold.

Aphid. Only one species of aphid, *Macrosiphum liriodendri,* seems to be common on tuliptree. These are rather small green aphids that occur on the underside of the leaves. A spray of malathion, lindane, or nicotine sulfate and soap will kill them.

Tuliptree scale, *Toumeyella liriodendri.* This is a large brown hemispherical soft scale that infests the branches of the tuliptree. This description applies to the females which reach a diameter of nearly one-third of an inch, but the males are small, flat, gray scales that are much less conspicuous. There is one generation each year and the young appear in September, crawl about for a time, then fix themselves to the bark and suck the sap. They are less than one-fourth grown when winter arrives. (See figure 149.) Spraying with miscible oil or lime-sulfur solution before growth starts in the spring will kill the scales. Malathion spray applied about April 15 or September 15 is also effective. See Circular 201.

Figure 149. Tuliptree scale.

Tuliptree spot gall, *Thecodiplosis liriodendri.* This gall shows from both sides of the leaves and is a circular brown spot surrounded by a circle of yellow or light green. Sometimes badly infested leaves will drop, but otherwise it is not serious. Usually control is not needed. However, spraying with DDT or malathion should be helpful in controlling the flies. For best results treatment may be made when the leaves are developing in May.

Turnip

For diseases see Cabbage

Aphids. The most important aphid infesting turnip is the turnip aphid, *Rhopalosiphum pseudobrassicae.* It occasionally causes considerable damage to turnips, especially rutabagas. Other aphids that sometimes infest turnip are the green peach aphid and the cabbage aphid. Dusting or spraying with malathion will control these aphids.

Cabbage maggot. The roots and underground stems of early turnip may be tunnelled by small, legless, white maggots which cause the plants to wilt and be stunted. They may be controlled by applying aldrin, heptachlor, or dieldrin to the soil near the base of the plants at the time plants are about an inch high. See Cabbage.

Other insects. Most of the insects infesting cabbage will occasionally feed upon turnip. See Cabbage.

V

Valerian

Stem rot, *Sclerotium delphinii.* Plants wilt and at the base of the stem is a cobwebby mycelium in which are embedded spherical sclerotia ranging from light buff to deep brown. Removal of affected plants and soil sterilization (see p. 4) is practical if infection has progressed very far. If incipient, a soil drench of mercury bichloride at 1:2000 (see p. 78) may be helpful.

Verbena

Powdery mildew, *Erysiphe cichoracearum.* This mildew appears as white moldy patches on leaves and young shoots late in the season and may be very destructive to greenhouse verbena. Regular sprays or dusts of sulfur applied as soon as the trouble appears are made as necessary.

Foliar nematodes, *Aphelenchoides ritzema-bosi.* Dark blotches on lower leaves, delimited by veins, spread upward on plants.

Aphids. The green peach aphid, *Myzus persicae,* sometimes infests verbena. The remedy is to spray with nicotine sulfate and soap, malathion, or lindane.

Verbena budworm, *Endothenia hebesana.* The larva of this insect is a borer in the new shoots of verbena and Physostegia, causing them to wither. The larva is greenish yellow with black head and is a little less than half an inch in length when mature. The adult is a purplish brown moth with wingspread of half an inch. Ordinary infestations can be controlled by handpicking or clipping and burning the infested tips. Spraying or dusting with DDT as soon as the first injury appears should give satisfactory results.

Garden fleahopper, *Halticus bracteatus.* The adult resembles a black plant louse and is about one-sixteenth of an inch long. The nymphs are greenish. Both suck the juices from the leaves and stems causing pale spots to appear. Badly infested plants may die. They survive the winter in the adult stage. Burning all weeds and trash in the garden before spring kills the overwintering adults. Spraying or dusting with DDT or malathion should kill both adults and nymphs.

Verbena leaf miner, *Agromyza artemisiae.* The tiny adult midge or fly lays its eggs in the tissue of verbena leaves and the maggots form blisterlike mines usually conspicuous from the upper surface of the foliage. Handpicking and destruction of infested leaves should be sufficient to control the usual infestation. Serious outbreaks can be controlled by spraying with lindane or malathion.

Yellow woollybear, *Diacrisia virginica.* Whitish, yellowish, or brownish hairy caterpillars feed upon the leaves of verbena and many other kinds of plants in the garden in late summer. This caterpillar is about 2 inches in length when fully grown and is covered with long hairs that vary in color from pale yellow to reddish brown. It makes its cocoon of its own hairy coat and silk, under rubbish, and in other sheltered places, sometimes 20 to 30 being clustered together. In this stage the insect hibernates and the moths emerge in June and July. The moth has a wing spread of between 1½ and 2 inches, and is pure white with a few black dots, blackish antennae, and orange abdomen with a row of black spots on the back and along each side. Handpicking is the usual means of control, but the plants may be protected by spraying with DDT, malathion, or lead arsenate.

Veronica

Leaf spot, *Septoria veronicae.* Brown circular spots appear on upper side of leaves, the underside of which are yellowish brown. Centers of spots may fall out giving the leaves a ragged appearance. Several sprays of ferbam, zineb, or Bordeaux will check the spread of this trouble.

Viburnum

Leaf spot, *Pseudomonas viburni.* Water-soaked spots on leaves and young stems enlarge into irregular brown sunken areas. Removal of infected leaves and wood may be coupled with sprays of Agri-mycin when leaves are half and full grown.

Powdery mildew, *Microsphaera alni.* White mealy appearance of leaves indicates presence of this fungus. Sulfur sprays or dusts applied before mildew appears or soon after appearance will check it.

Aphids, *Anuraphis viburnicola.* The leaves are curled and stunted in early spring.

The grayish to dark green aphids secrete honeydew in which sooty fungus grows, resulting in unsightly, distorted foliage. Control of the insects may be obtained by spraying with malathion between April 1 and 15. See Bulletin 588.

Violet

For diseases see Pansy

Aphids. The violet aphid, *Micromyzus violae,* and probably also the green peach aphid, *Myzus persicae,* occasionally infest *violae,* and probably also the green peach spraying with nicotine sulfate and soap or malathion. Aerosol bombs should control this pest in commercial greenhouses. Spraying with DDT or malathion should also be effective.

Figure 150. Anthracnose on violet.

Eelworms. Eelworms often infest the roots of violet. See Tomato, root knot.

Garden slugs. Garden slugs often feed upon the leaves of violet. See Primrose.

Violet gall midge, *Phytophaga violicola.* The small two-winged fly or midge lays white eggs in the curled margins of the unfolded new leaves. These eggs hatch, and the maggots remain in the curled margins, causing greater curling, distortion, and twisting of leaves. There are probably several generations annually in greenhouses. Aerosol bombs should control this pest in commercial greenhouses. Spraying with DDT or malathion should also be effective.

Violet sawfly, *Emphytina canadensis.* The leaves of violet plants in the garden are often eaten at night by blue-black larvae with whitish tubercles. These larvae hide under the lower leaves or in the soil during the day. When full grown they are about half an inch in length. The adult is a black four-winged fly or sawfly about five-eighths of an inch long that lays eggs in blister-like incisions in the leaves. There is only one brood each year. Spraying or dusting with DDT, malathion, or lead arsenate will be useful in controlling this insect. Several treatments may be necessary.

Yellow woollybear. The caterpillars sometimes feed upon violet. See Verbena.

Virginia-creeper

Eight-spotted forester, *Alypia octomaculata.* Caterpillars cross-banded with black, white, and orange feed upon the foliage of Virginia-creeper, sometimes stripping the vines. The adult is a black moth with wingspread of from 1¼ to 1½ inches, with two pale yellow spots on each forewing and two white spots on each rear wing. The insect winters as pupa in the soil, and there is only one generation each year in Connecticut. Handpicking is the only control needed, except occasionally when the insect is very abundant, in which case a spray of DDT, malathion, or lead arsenate will prove effective.

Leafhoppers, *Erythroneura vulnerata.* This and probably other species infest the leaves of Virginia-creeper. Control measures are needed only when leafhoppers are exceedingly abundant, and a spray of DDT or malathion directed against the undersides of the leaves is perhaps the best treatment.

Sphinx caterpillars. See Grape.

Woodbine vein gall, *Dasyneura parthenocissi.* This gall is somewhat irregular in shape and occurs on the underside of the leaf along the midvein. Control measures are usually unnecessary. Spraying with DDT or malathion should kill the adults.

W

Walnut

For diseases see Butternut

Aphids. The large gray aphid, *Longistigma caryae*, is found on Japanese walnut. The black walnut is infested by the three hickory aphids, *Monellia caryae, M. caryella,* and *M. costalis*. Spraying with malathion or nicotine sulfate and soap is the remedy.

Oystershell scale. The oystershell scale often infests walnut. See Lilac.

Walnut bud moth, *Acrobasis caryae*. The caterpillars of this moth feed upon the tender terminal leaves and shoots, webbing them together, and injure and distort the new growth or stop it entirely. The full-grown larva is about five-eighths of an inch in length, and of a dirty olive-green color with shining black head. The adult moth has a wingspread of about three-fourths of an inch and is gray with lighter areas at the base of the forewings. This insect is readily controlled by a DDT or lead arsenate spray such as is used against the walnut weevil.

Walnut caterpillar, *Datana integerrina*. This caterpillar is usually noticed in August when clusters of black caterpillrs with whitish hairs are found stripping the branches of walnut and hickory. On the trunks and larger branches may be seen gray hairy patches where the flock of caterpillars have molted or cast their skins. The mature caterpillars are about 2 inches in length, black, and covered with whitish hairs. The adult moth has a wingspread of about 2 inches, is light reddish brown in color, the forewing crossed by darker reddish lines, and with a bright mahogany-red spot on the thorax. The moths emerge in July and lay clusters of eggs on the underside of the leaves. The caterpillars become mature in September, pupate in the ground, and remain there until the moths emerge the following season. There is only one generation each season. Control consists of spraying the foliage with lead arsenate or DDT about August 1. On small trees the caterpillars may be gathered and crushed.

Walnut scale, *Aspidiotus juglans-regiae*. The Persian walnut and the Japanese walnut are sometimes infested by this circular light gray scale that is about one-eighth of an inch in diameter. Its life history is similar to that of the San Jose scale. It may be controlled by a dormant spray of lime-sulfur or miscible oil. Spraying with malathion late in June and at intervals of 4 weeks until the end of September will be helpful in controlling crawlers.

Walnut weevil, *Conotrachelus juglandis*. This insect breeds in the nuts and new shoots of walnut, and often severely injures Persian and Japanese varieties. The adult is a snout beetle, about one-fourth of an inch long, brownish gray in color, with a broad whitish band across the wing-covers just beyond the center. The beetles hibernate in protected places, appear on the trees the latter half of May, and eat holes into the shoots and leaf stems. The females lay eggs in both the fruit and stems under flaps in crescent-shaped punctures, like the plum curculio. The young lrvae tunnel in the new shoots, at the base of the leaf stems, and some go into the fruit. They mature in 4 to 6 weeks, then enter the ground where they pupate about an inch beneath the surface and from 16 to 20 days later the adults emerge. The beetles do some feeding, then early in September seek their winter quarters. There is one annual generation. This insect may be controlled by thoroughly spraying the new shoots and leaves with DDT or lead arsenate in early June.

Watercress

Diamond-back moth. The larvae of this moth feed upon watercress. See Cabbage.

Spinach aphid. The spinach or green peach aphid sometimes infests watercress. See Spinach.

Watercress leaf beetle, *Phaedon aeruginosus*. This is a small bronze-black beetle about one-eighth of an inch in length. The full-grown larva is about one-fifth of an inch long and brownish black with numerous tubercles bearing hairs. Both adults and larvae feed upon the underside of the leaves of watercress. Control is not usually necessary.

Watercress sowbug, *Mancasellus brachyurus*. This gray shrimp-like sowbug, about half an inch in length, eats off the roots and submerged stems of watercress, causing large

masses to float upon the surface of the water. In natural streams and ponds there is no satisfactory control. In artificial pools where the water can be drawn off, the sowbugs can be concentrated in a trough at the bottom and later killed by the application of copper sulfate.

Waterlily

Aphids. The waterlily aphid, *Rophalosiphum nymphaeae,* infests the leaves of waterlily. Malathion sprays may be used if necessary.

Leaf beetles. At least three different kinds of beetles feed upon the leaves of waterlily. Possibly dusting or spraying the leaves with lead arsenate would prevent injury in ornamental pools.

Watermelon

For diseases see Cucumber

Melon aphid. The melon aphid sometimes infests watermelon. See Melon.

Melonworm and pickleworm. These insects will attack watermelon on rare occasions. See Melon, also Cucumber.

Squash beetle. The squash ladybeetle occasionally feeds upon the leaves of watermelon. See Squash.

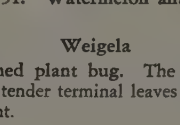

Figure 151. Watermelon anthracnose.

Weigela

Four-lined plant bug. The bugs often injure the tender terminal leaves of weigela. See Currant.

Wheat

See Small Grains

Willow

Blight, *Venturia chlorospora* and *Physalospora miyabeana.* These fungi cause a blight which blackens and shrivels leaves (scab) and produces black lesions (black canker) on branches. Trees die from repeated infections. The disease may be reduced by pruning and burning infected wood in early spring followed by application of several protective sprays of ferbam, thiram, or Bordeaux when leaves are half grown, full grown, and again 10 days later. Later sprays may be needed if prolonged wet weather occurs. Sprays applied as for apple scab give good control.

Cankers, *Botryosphaeria ribis, Valsa sordida.* Small black sunken cankers appear on twigs, branches, and trunks of willows. These may kill a tree within a period of a few years. No control is known. Vigorous trees may resist infection better than those weakened by blight or winter injury.

Winter injury. Alternate freezing and thawing of bark on the south or southwest side of a tree during late winter causes long vertical cracks which may be later invaded by insects or fungi. A wide board leaning against the tree on the exposed side will prevent the sun's rays from warming the bark on days in late winter when night temperatures drop below freezing. Painting the trunk white will accomplish the same result.

Rusts, *Melampsora* sp. The uredial and telial stages of these rusts appear as orange and red blisters on the underside of the leaves and are self-perpetuating. The alternate hosts of these different rusts are balsam fir, larch, and *Ribes* spp. The willow-larch mycelium can overwinter in terminal buds, young stems, or catkins. Control is usually unnecessary, but in nurseries elimination of alternate hosts and prompt pruning and destruction of infected wood, in the case of willow-larch rust will be found helpful.

Crown gall, *Agrobacterium tumefaciens.* Irregular swellings are found at the base of the trees or on roots of nursery trees. No control has been worked out, although wounding is thought to be the means by which the bacteria enter the tree.

Tar spot, *Rhytisma salicinum.* Thick black raised spots like a blob of tar appear on leaves. Raking and burning fallen leaves gives sufficient control.

Aphids. Several species of aphids infest the willows. One of the commonest is *Clavigerus smithiae.* The purplish aphids are on the small twigs in the fall, and eggs are laid to carry the species through the winter. Another species, *Chaitophorus viminalis,* has also been recorded on willow from Connecticut. These aphids may be controlled by spraying with malathion or nicotine sulfate and soap.

Fall webworm. The fall webworm feeds upon willow. See Pear.

Gypsy moth. The caterpillars of the gypsy moth feed upon willow. See Oak.

Imported willow leaf beetle, *Plagiodera versicolora.* Dark metallic blue, shiny beetles, an eighth of an inch in length, and their larvae, feed upon the leaves of willow, especially the glossy-leaf varieties. The adult beetles hibernate under bark and in other sheltered places and emerge in April and May. The females lay yellow eggs in clusters on the underside of the leaves. These eggs hatch in 4 or 5 days and the grubs feed on the leaves, eat away the lower tissue and leave only the veins and upper epidermis. The grubs are bluish-black, alligator-like larvae that skeletonize the foliage, but the beetles may eat holes through the leaves. There are two generations each season. The treatment is to spray with lead arsenate or DDT in April and May.

Mite galls, *Eriophyes* sp. These are very common on willow, but little is known about them. Spraying with malathion or aramite when the leaves are developing in the spring should be useful in control.

Oystershell scale. The oystershell scale commonly infests willow. See Lilac.

Poplar and willow curculio. This insect is a borer in willow and has killed many fine specimens of pussy willow during the past few years. See Poplar.

Poplar leaf beetles. These beetles often feed upon willows, especially basket willows. See Poplar.

Poplar tentmaker. This insect also feeds upon willow. See Poplar.

Spiny elm caterpillar. The caterpillars feed upon willows. See Elm.

Willow cone gall, *Rhabdophaga strobiloides.* This is a gray or brown cone-shaped gall about an inch long on the tips of willow shoots. The egg is laid by a small two-winged fly or midge in early May and the gall reaches maturity in June. There is evidently one brood each year. If control is required, spraying with DDT or malathion when the adults are emerging in April and May should be effective.

Willow shoot sawfly or currant stem girdler. This is a wasp-like insect about half an inch long. It appears in early spring and lays eggs in the new shoots of willow, girdling the stem below the egg. The larvae are borers in the shoots, sometimes tunneling them for 2 feet, reach maturity in November and transform in the shoots. Cutting and burning the wilted shoots will be helpful in controlling this insect. Spraying with DDT in early spring should also destroy many of the adults.

The yellow-spotted willow slug. The greenish-black sawfly larvae about half an inch long feeds upon willow and poplar leaves. There is a row of yellow spots along each side of the body. Spraying with DDT or arsenate of lead is the control.

Scale. See Maple, terrapin scale.

Wisteria

Mealy flatas. These insects are often found on wisteria. See Lily.

Silver-spotted skipper. The caterpillars feed upon the leaves of wisteria. See Locust.

Y

Yew

See **Taxus**

Yucca (Spanish Bayonet, Adams Needle)

Leaf spot. Several fungi cause spotting of yucca leaves. Cutting and burning infected leaves may be combined with several Bordeaux sprays, plus spreader, spaced about a week apart.

Z

Zinnia

Powdery mildew, *Erysiphe cichoracearum.* White mealy growth is found in patches on the upper side and underside of leaves and on the stems and flowers in late summer. Sulfur sprays or dusts applied regularly from mid-July on give good control.

Foliar nematodes, *Aphelenchoides ritzema-bosi.* Angular spots delimited by veins appear first on bottom leaves. Eventually the whole leaf is involved and turns brown. Leaf-browning progresses up the plant. When the plant is covered with a thin film of water from rain or heavy dew, the eelworms which cause the trouble emerge from the interior of the leaves and swim up the stem to infect the leaves above. Avoid sites where zinnias or other susceptible hosts have been grown.

Japanese beetle. See Rose.

Stalk borer. The stalk borer often infests zinnia. See Dahlia.